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SOME LOW-COUNTRY PRODUCTS.

Some results of the first year's trials of various tropical low-country products at Anuradhapura referred to in Progress Reports of the station are now available for the season 1914-15. The station is 295 feet above sea level; has an average annual rainfall of 54·95 inches and a mean temperature of 80·3° F. The planting season is during the North-East Monsoon—September to December—when the bulk of the rain falls. The station is therefore typical of large areas in the tropics of the Eastern hemisphere: one short heavy rainy season followed by a long period of more or less dry weather. The soil is a deep loam and the land newly cleared of low forest.

We tabulate below the yields from some of the crops tried. One year's trials with new seed in a new country, as is the case with many of the crops, must naturally be inconclusive. Some crops suffered from excessive rain through being sown too early; others languished in drought through being sown too late in the monsoon. Storm-rain courses swept through some of the plots and drowned them out. Such casualties, which can be anticipated and guarded against to some extent in the future, have their effect upon results at the present:—

	Yield per acre. Bushels.	Measures.*	Weight per bushel. lb.
Arachis hypogæa, Groundnut ...	28	14	$26\frac{3}{4}$
Eleusine coracana, Kurakkan ...	15	20	62
Dolichos biflorus, Horse gram ...	7	14	68
Guizotia abyssinica, Niger seed ...	2	14	48
Glycine soya, Soya bean ...	0	20	
Panicum miliare, Little millet ...	14	18	47
P. furmentaceum, Poor man's millet ...	15	0	38

* 28 measures=one bushel.

	Yield per acre. Bushels.	Measures.	Weight per bushel. lb.
Paspalum scrobiculatum, Kodo millet ...	18	7	50
Phaseolus mungo, Black gram ...	3	11	53
P. radiatus, Green Gram ...	6	12	63
Setaria italica, Italian millet ...	8	14	53
Sesamum indicum, Gingelly or simsim, brown	0	21	49
S. indicum, white ...	1	21	49
S. indicum, black ...	1	2	49
Sorghum, Indian, Skaladagdi, white ...	2	0	56
Sorghum, ,, Perio, ,, ...	3	21	56
Sorghum, ,, Sundia jower ,, ...	3	0	63
Sorghum, ,, Imphi ,, ...	2	4	56
Sorghum, Soudan small white ...	16	2	56
Sorghum, ,, giant ...	16	0	58
Sorghum, ,, large yellow ...	22	14	53
Sorghum, ,, small brown ...	15	25	55
Vigna catjang, Cow pea, white ...	1	12	63
V. catjang, large purple ...	15	21	62

The Millets as a class did well. The Panicums were not quite up to good average Indian yields, though the Paspalum compares favourably with them. The growth of the Indian Sorghums was very level but the yields were disappointing ; the Soudan Sorghums, a new importation, cropped much better, equalling and, in some cases, surpassing the popular Kurakkan which they excel in quality as food for man or beast besides giving abundant straw. The red-headed variety, which hitherto has enjoyed special immunity from bird attack, and appears to be immune from mould and smut, yielded at the rate of 17 bushels per acre at Peradeniya but was not tried at Anuradhapura. It would probably have yielded more but for too wide planting—a mistake made with many of the crops at Anuradhapura also—which can easily be rectified. The large purple cow pea *(Vigna catjang)* cropped well ; it is a good green manure. Pigeon pea *(Cajanus indicus)* though not yet harvested looks at the present time very vigorous though rather too closely planted. Safflower was a complete failure ; Soya bean almost so

One of the most healthy of the plots now to be seen is that of Arrowroot, which was planted in furrows two feet apart, on the ridge and furrow system. 200 young Robusta coffee plants in the Mahailuppalama nurseries are to be put out this year at Anuradhapura. They look very promising, as do also the Citrus trees—orange, mandarin, lime and citron—now in bearing at Mahailuppalama.

R. N. L.

COCONUTS.

THE SELECTION OF COCONUTS FOR SEED.

In connection with the propagation of coconuts it is a widely held belief that the nuts from young trees should not be used and that plants should only be raised from fully-matured trees.

This belief appears to be based on the following passage from SIMMONDS' TROPICAL AGRICULTURE* :—"The nuts for sprouting should be chosen from those fully ripe, having full, large eyes, § and such as have been gathered from trees past the middle age—not, however, from aged ones—and from clusters containing few fruits. These, if carefully planted, are said to ensure the timely sprouting and steady growth of the plant as well as future luxuriance, longevity, and unintermitting fruitfulness.....Those nuts which may be taken from trees of immature age will, if planted, rot away at the eye ; and the plants,—if any be successfully reared,--on transplanting will grow very rapidly and acquire bulk, but the fruit will drop before the kernel acquires consistency, the root stalks break, and the trees entirely fail before mid age."

Efforts have been made to discover what truth there may be in the above statement, but neither direct confirmation nor absolute refutation has been obtained. On physiological grounds there would appear to be no justification for the statement as it stands, though no doubt it would be unwise for more than one reason to plant nuts from young trees in the first year or two of their coming into bearing.

We have failed to find any earlier reference in economic literature to the statement made by SIMMONDS, and it is not impossible that he may have based it on a superstitious native belief which had come to his notice. But all attempts to trace its origin have so far been unsuccessful. It is, too, not inconceivable that the statement may merely embody the argument of the owner of a plantation, containing trees of a particular age, which was being offered for sale.

The following passage taken from a recent book on the Coconut, by E. B. COPELAND,† deals with the vexed question of the seed nuts, and contains useful practical suggestions:—

"B. *Selection of the seed.*—Whatever variety of coconut may be chosen, the seeds which are to be planted should be selected as the product of individual trees, and these trees should be very carefully picked out and should be the ones which most exactly have the qualities which it is desirable to give to the entire plantation. There is no point in the coconut business where careful personal attention is more necessary or will prove more profitable than in the selection of the trees which are to furnish the seed nuts. Leaving out of account selection for any of the minor uses, and

* SIMMONDS, P. L., TROPICAL AGRICULTURE, pp. 220, 221. London, 1877

§ We are not aware how this quality of "full, large eyes" could be detected in seed nuts which are always planted in husk.—Ed. T. A.

† The Coconut. E. B. COPELAND, London. Macmillan & Co., Ltd. pp. 116-118.

considering only the production of copra or oil, there is one safe and sufficient rule. Select the seed of trees which are conspicuously more productive than are their neighbours which are growing under the same conditions.

"If a tree is especially productive because it grows in especially rich soil, or because it is well watered or well fertilized, or because it is freely illuminated on all sides, then, no matter how conspicuously productive it may be, there is no sound reason for choosing it as the source of seed. Seeds are chosen for their hereditary qualities, and a good environment cannot be inherited. A tree in the middle of a grove which regularly produces more nuts or larger nuts than its neighbours, and is without any compensating drawback, should be selected as the source of seed, even though a tree at the outside of the same grove which is still more productive be passed over.

"The selection of nuts from piles or at any time after they are cut from the tree is not to be recommended. A tree bearing very few nuts is for that reason likely to bear large ones, and it will thus often happen that the selection of large nuts from the nut pile is in effect selection from trees which are not very productive. Moreover, there is a chance that the large nuts in general nut piles are from trees which produce large nuts because they grow under especially favourable conditions, and, as we have just seen, there is no reason whatever why the fruit of such trees, however good it may be, should be selected for propagation.

"When the trees which are to be the source of seed nuts have been selected, their nuts should be regarded as having a value which is based on the value of the trees they will produce, and are therefore out of all proportion to the value which they have as mere nuts. It is worth while to harvest these nuts with a care which would be economically impossible for nuts intended for the production of copra. It is well worth the while to collect the nuts of a good seed tree by lowering them to the ground by hand in order that there can be no risk of breaking or cracking them. A cracked nut will never germinate.

"The nuts are ready to be used for seed at the same time at which they are really ready to be used for copra,—that is, when a third or a half of the water in the interior cavity has been used up. This condition can be recognized by the heaviness of the nut and by the noise which it makes when shaken."

The following paragraph taken from the "DIRECTIONS FOR PLANTING COCONUT TREES," issued by the Board of Agriculture, British Guiana, contains information very similar to that given by COPELAND:—

Selection of Seeds.—Nuts which are quite ripe should be chosen from trees which bear good crops of nuts having thin husks and thick kernels (copra), and which are neither very young nor very old. They should either be picked and not allowed to fall, as by so doing they may be injured, or, if not picked, fallen ripe nuts should be selected with uninjured husks; they should be kept a month before sowing. The larger ones on the bunches should be selected for planting, but very big nuts are not always the best, because only a few may be borne on the tree, while frequently their size is due to excessive development of husk at the expense of the kernel; oblong nuts should be avoided. The large orange-red variety is the best for planting, in view both of size of coconut and of yield of copra."

One of the chief reasons, no doubt, for the recommendation that nuts should be taken from trees of some maturity is that the character of the nuts yielded by such trees would be well known, and it is probable that the nuts borne by quite young trees would not show their true character.

The following extract relating to seedling coconuts in the Laccadives * is also of interest in connection with this subject :—

"In most of the islands it is deemed necessary to raise the seedling coconuts with care and attention till they are a year old, when they are transplanted and watered for a few weeks till they become firmly established. After this the young trees are left entirely to themselves, and are neither watered nor manured ; they come into bearing in Kiltan in from 8 to 10 years ; and produce fruit so vigorously and plentifully that it is sometimes necessary to support the luxuriant growth of nuts artificially ; in this island, moreover, the preliminary attention to seedlings is not required.

"In some of the other islands, as in Chitlac, where the soil is much poorer, the trees do not come into bearing till they are 15 to 20 years old, each tree at best producing only about 50 nuts per annum as against 80 to 85 nuts a year in Kiltan. In Kadamum, too, backward though the cultivation in that island is, the average per annum is about 80 nuts per tree ; in Ameni, where the cultivation is almost as extensive as in Kiltan, the average is only about 60 nuts a year from each tree. These figures are given by ROBINSON, after careful and prolonged inquiry, as representing the yield in 1844 and 1845 : HUME gives the average all over for the four British islands in 1875 at 80 nuts per tree per annum—doubtless rather a high general estimate, though probably representing the yield of what the people in any of the islands would themselves consider a good tree. ROBINSON thinks that 60 to 70 nuts would be a pretty fair general average for the whole of these islands, and this is likely to be nearer the truth than the higher estimate. The islanders try to plant only first-class trees, and they aim at obtaining such as will come into full bearing in about 10 years, throwing out every month after that age is reached a fruiting spike bearing 15 to 20 nuts, and so yielding 180 to 240 nuts a year, and going on bearing, at this rate till they are 60 years old. They often do go on bearing, it is said, till they are 70 or 80 years of age, and some are believed by the people to be more than a century old."

Young coconut trees vary considerably in the age at which they commence to yield, and in some cases as many as ten years may elapse before any nuts are borne. In pronouncing an opinion as to the proper age or size of trees from which seed nuts should be selected, it would be better therefore not to take nuts for this purpose until the trees are at least in their third or fourth year of bearing. Judging from particulars received of coconut plantations in the Island of Nevis, West Indies, it would appear that coconut palms in their third year of bearing yield perfectly sound and full-sized nuts, which, when used for seed, can be relied upon to germinate freely and in a normal manner.

The plantations in Nevis were started by MR. CRUM-EWING in the autumn of 1907 on old sugar-cane land, which is almost at sea-level. The soil is a nice loam, gradually getting lighter until it becomes pure sand on the sea-shore.

* BOTANY OF THE LACCADIVES, D. PRAIN in JOURN. BOMBAY NAT. HIST. SOC., 1892, sec. 2, No, 5, pp. 65, 66.

The average rainfall for the years 1909-13 inclusive was 43·87 inches, but the deficiency is compensated for by the plentiful underground supply of water draining from the high cone-shaped mountain which forms the centre of the small circular Island of Nevis.

The seed was obtained from Jamaica by Mr. Barclay, Secretary of the Jamaica Agricultural Society, who took some trouble to obtain nuts from the most healthy plantation in that Island. The seed for that plantation in turn came from San Blas, whence come the finest nuts in the Western Hemisphere.

The number of nuts planted up to the end of 1911 amounted to 10,305. The trees are planted 28 feet apart, 52 to the acre. Certain trees commenced to bear in 1911, and Mr. Crum-Ewing saw one early in 1912, 4 years, 4 months old, bearing 40 nuts. Reaping in any quantity, however, did not commencce till 1913, when the 1907 plants would be about 5 years and 3 months old.

From January 11th, 1913, to June 30th, 1914, the number of nuts harvested amounted to 23,807. From January 11th to October 23rd, 1913, a 4-in. gauge was used, which resulted in 77·4 per cent. of selects and 22·6 per cent. of culls. Both selects and culls were sent to New York, where the market took both grades as select, paying $42·50 per 1,000, about the highest price which has been paid for any coconuts in that city. Since October 23rd a $3\frac{7}{8}$ in. gauge has been used (which is $\frac{1}{8}$ in. larger than the Malay regulation gauge of $3\frac{3}{4}$ in.), and of the 75,116 nuts gathered, 68,419 or 91·08 per cent. have been select, and 6,697 or 8·92 per cent. have been culls. A selection is made in the field of the nuts while in the husk, and it is found that 95 to 98 per cent. of these nuts when husked are over the $3\frac{7}{8}$ gauge.

In choosing nuts for seed, greater care is bestowed on selection than when husking and selling raw nuts is contemplated, so that the percentage of standard nuts would be increased. A certain number of trees are known not to give such a good percentage of selects, although the unhusked nuts from them look good. When selecting nuts for seed none are taken from these trees, which still further reduces the percentage of culls. The rots will not of course germinate, so that of the sprouts taken from the nursery, it may safely be assumed that nearly 100 per cent. are from nuts over the $3\frac{7}{8}$ in. standard.

Out of 1,000 seed nuts sent to Demerara in July, 1913, it was reported on February 28th, 1914, that 89 per cent. of these had germinated, that the others seemed quite good, and that more were expected to grow. In March, 1913, 50 nuts were planted standing up and 50 on their sides by way of experiment in Nevis. On October 24th, 1913, it was reported that out of the 50 on their sides 46, or 92 per cent., had germinated, and of those standing up only 30 or 60 per cent. had germinated.

The high percentage of good-sized nuts on the young plantations at Nevis is of both general and commercial interest and affords ample justification for the great trouble which was taken in selecting the original seed nuts in Jamaica and elsewhere. As to the selection of the seed Mr. Crum-Ewing writes :—"I do not understand Simmonds' advice to take seed nuts from clusters containing few fruits—on a prolific tree there should be no

such clusters. I quite agree with you that seed nuts should be taken from trees whose good character is well marked. It appears to me that the pedigree of a coconut tree is of the utmost importance. Even if I had only one or two years' experience of a tree, and it showed the same characteristics, for which its parent, and yet again its grand-parent, had been selected, I would rather use the seed from that tree than take SIMMONDS' advice to choose one picked from a sparsely furnished cluster grown on a tree past the middle age, of whose parentage there is no record."

The nuts which are now being planted on MR. CRUM-EWING'S land in Nevis and in Demerara are taken from the young trees planted in Nevis in 1907. As already mentioned, the germination percentage of nuts sent from Nevis to Demerara in July, 1913, was 89 per cent., which certainly refutes the statement made by SIMMONDS that nuts from young trees "rot away at the eye." MR. CRUM-EWING informs us that he is planting nothing but his own Nevis seed both in the Island and in Demerara, and adds :—"I feel justified in so doing, knowing the great care with which the seed is selected, the minute observation to which the individual trees have been subjected, the absence of disease in the grove and in the Island, and the good stock from which the parents and grand-parents were derived."

These experimental plantings should, in the course of a few years, enable a proper estimation to be made of SIMMONDS' statements, but in the light of the practical experience already gained, it seems highly unlikely that his recommendations will receive support.—KEW BULLETIN.

EXPERIMENTS WITH COCONUTS.

AT MAHAILUPPALAMA EXPERIMENT STATION.

The first picking of 1915 was made on February 25th. The number of nuts collected was 965 from 284 trees, an average of 3·5 nuts per bearing tree, or 0·59 nuts per acre tree.

This is the yield from an area of 23½ acres, composed of plot A, 17 acres of 6 year old trees and plot B, 6½ acres of 7 year old trees. (Number of trees per acre 70).

In the irrigable area (6 year old trees) consisting of 1,224 trees, 259 trees gave 887 nuts, an average of 3·5 nuts per bearing tree.

In the unirrigable area (7 year old trees) consisting of 449 trees, 25 trees gave 78 nuts, an average of 3 nuts per bearing tree.

The second picking of 1915 comprising the produce of the months of February and March was made on April 7th.

The number of nuts collected was 1,593 from 341 trees, an average of 4·5 nuts per bearing tree or 0·90 nuts per acre tree.

This gives a total of 2,558 nuts for the year 1915 to date from an area of 23½ acres as detailed above.

In the irrigable area, 310 trees gave 1,462 nuts, an average of 4·75 nuts per bearing tree.

In the unirrigable area, 31 trees gave 131 nuts, an average of 4·25 nuts per bearing tree.

The following figures have been obtained with regard to copra production :—

COMBINED PLOTS.

Picking.	Break.	Rejections.	Copra lb.	No. of Nuts required per Candy.
September, 1914 ...	1,968	½	946	1,159
October, 1914 ...	1,235	0	548	1,260
November & December, 1914 ...	900	1	384	1,296

PLOT A (IRRIGABLE.)

September, 1914 ...	1,842	1	857	1,197
October, 1914 ...	1,178	0	518	1,273
November & December, 1914 ...	848	1	363	1,292

PLOT B. (UNIRRIGABLE.)

September, 1914 ...	126	0	89	792
October, 1914 ...	57	0	30	1,064
November & December, 1914 ...	52	1½	21	1,360

For the year 1914 the average number of nuts required to produce a candy of copra was :—

In the case of the combined plots	...	...	1,239
In the case of Plot A	...	...	1,226
In the case of Plot B	...	...	1,357

—PROGRESS REPORT.

G. HARBORD.

AT PERADENIYA EXPERIMENT STATION.

Groups of 4 palms each were selected on the Getambe plot and Kanganie's Line plot. One group of each was manured with a general mixture containing 60 lb. each of Nitrogen, Potash and Phosphoric acid per acre, of 60 palms or one pound of each constituent per palm, and three other groups with similar mixtures in duplicate but omitting one essential constituent from each plot.

The groups of 8 years old coconuts are kept disced and cultivated and the 12 year old groups are under grass ; otherwise they are duplicates of the 8 year old coconut plot.

The following are the manures for palms 8 years old and for palms 12 years old :—

Plot 1. NITROGEN AND POTASH ONLY.

Ammonium sulphate	300 lb. per acre	5 lb. per palm.
Sulphate of Potash	120 ,, ,,	2 ,, ,,
		7 lb. per palm.

Supplying 1 lb. each of Nitrogen and Potash per palm.

Plot. 2. NITROGEN AND PHOSPHORIC ACID ONLY.

Ammonium sulphate	300 lb. per acre	5 lb. per palm.
Ordinary Superphos.	333 ,, ,,	5·6 ,, ,,
		10·6 lb. per palm.

Supplying 1 lb. each of Nitrogen and Potash per palm.

Plot 3. PHOSPHORIC ACID AND POTASH ONLY.

Ordinary Superphos.	333 lb. per acre	5·6 lb. per palm.
Sulphate of Potash	120 ,, ,,	2·0 ,, ,,
		7·6 lb. per palm.

Supplying 1 lb. each of Phosphoric acid and Potash per palm.

Plot 4. NITROGEN, POTASH AND PHOSPHORIC ACID (Basic).

Nitrolim	333 lb. per acre	5·6 lb. per palm.
Basic slag	300 ,, ,,	5·0 ,, ,,
Sulphate of Potash	120 ,, ,,	2·0 ,, ,,
		12·6 lb. per palm.

Supplying 1 lb. each of Nitrogen, Potash and Phos. acid per palm.

Some very large nuts are being obtained from the 12 year old palms, the seed of which came from Java. The dried nut weighs 7¾ lb. ; after husking 2½ lb.: Water 1 lb.; shell and meat 1½ lb.; thin shell ½ lb.; weight of copra 9 oz.; thickness of copra-kernel ¼ inch.

These are being planted in nurseries with a view to establishing a plantation for seed nuts.—PROGRESS REPORT.

D. S. CORLETT.

The enormous productiveness of tuberous crops like the potato are not ordinarily realised. During the past six years trials have been conducted in Surrey with a view to ascertain the possible yields of one pound of seed potatoes under ordinary garden cultivation, without the aid, however, of glass or hot air. Since these trials were begun the yields have increased steadily each season. Last year two growers lifted 364½ and 351 lb. of sound tubers from the original pound of seed tubers. The variety grown was William's Colleen raised in County Cork.

THE GARDENERS' CHRONICLE (April 3) quotes the testimony of one of its correspondents as to the value of swans in keeping ponds and lakes clear of weeds. The birds are not supposed to do this by actually eating all the weeds. They may feed partially on them but accomplish the work of destruction by biting and tearing. They do this in the search for insects, worms and small shell fish harboured by aquatic plants, but they are believed not to destroy ordinary fish.

RUBBER.

V SYSTEM OF TAPPING.

Our readers have hardly had time to forget the manner in which the V system of tapping was rejuvenated a couple of years ago by many visiting agents in the East. We might usefully recall the fact that the V was almost the first method of tapping adopted when Hevea was many years ago exploited by scientists and planters in Ceylon and Malaya. Later on it gave way to single cuts, sloping at an angle of 45 degrees, positioned one above the other. There were as many as four or six cuts on the same side of the tree, each provided with a cup at the lower end. Still later these cuts were connected by a shallow vertical groove in the bark so as to form quarter-section, herring-bone, and other systems. A couple of years ago the yields from many estates were far from satisfactory, and visiting agents and responsible managers proclaimed their belief that salvation lay, not in a change of frequency, but in one of system. They also invariably pronounced in favour of a big V encircling half the tree. That view was based on evidence but a few months old. It was not, to our knowledge, based on experiments controlled, nor were the deductions arrived a tby scientific men.

We at once contested the claims made, and gave our reasons for doing so. We pointed out that any tapping line must obviously draw latex from the surrounding bark, and that the closer the tapping lines to one another the more the incisions would tend to draw latex from the bark area. These obvious facts were not disputed. But when we continued the argument by pointing out that in the V method two lines actually came into contact, and therefore drew near the apex on the same area of bark we were simply told that the system was giving very good yields. Furthermore, one of the most active supporters of the V method took up our challenge and appealed to a certain director of agriculture in the East, who gave a letter to the effect that "the V system was agriculturally sound." This we again contested, and awaited developments. We could not accept mere adverse statements as a proof that our conclusions were wrong.

It now appears that the publicity given to the subject resulted in numerous experiments being conducted with the object of determining the values of different systems of tapping. We are pleased, but by no means surprised, to learn that these results agree with our original views. A knowledge of the autonomy of Hevea bark enabled one scientist to arrive at our view without going to the expense and trouble of experiments.

The reasons given for originally recommending and now abandoning the V by visiting agents are not the same. We have received letters from visiting agents on the subject, and will content ourselves by publishing essential portions of their communications. One visiting agent deals with his own position in such a logical manner, giving his reasons for (*a*) recommending the V. (*b*) for being sceptical on the subject, and (*c*) for abandoning the V that we cannot do better than give his views under these headings.

His reasons for originally recommending the V method of tapping were as follows :—

"1. That I did not doubt that the basal V gave better results on small trees than two quarter-stem half herring-bone cuts.

"2. That on young trees better tapping could be effected on the thicker basal bark than on the thin bark of the upper of two half-herring-bone cuts.

"3. That the use of the V for two years on young trees would not do any damage or be an obstacle to a future introduction of the half-herring-bone system if the V system should meanwhile prove a failure."

While taking the above views the same agent had reasons to doubt the soundness of the method, for the following reasons :—

"1. The botanical reason that after the second half-stem V is opened the food transport in the sieve tubes must for some time be interfered with too seriously.

"2. The experiments on which the propaganda for the V system was based had only lasted for three years, and could therefore at most have shown that the basal V gives more rubber than two half-herring-bone cuts, but nothing as to the consequence of continued V tapping.

"3. That it is easier for coolies to tap properly in only one direction than in two. If they cut downwards on both sides of the V they will have to put leverage on the knife in two opposite directions."

After several years' experience he gives the following reason why he now abandons V tapping :—

"On a small estate on which I was manager tapping was begun in 1910, and up to 1912 all young trees were opened up with a half-stem V. The quality of the tapping was good for that time. The estate has always been well kept, but only little cultivation has taken place. From the middle of 1913 the output stopped increasing, though new trees were still being taken into tapping rounds. This and the reports of similar results from other estates have convinced me that the V system even for young trees is a severe one, and that it ought to be abandoned in favour of a one-cut quarter-stem half-herring-bone system, to be followed by a two-cuts quarter-stem half-herring-bone system when the trees are eight years old."

It will be observed that the visiting agent here quoted abandons the V because of the bad effects on young trees. The reason given is, we admit, sufficiently strong, but we would like to hear the views of agents who have come to a similar (or opposite) conclusion as a result of experience gained in the tapping of larger and older trees.—India Rubber Journal.

SMOKED SHEET.

The premium on ribbed smoked sheets has been maintained, only in part, during the present year. During the present month the difference between first quality crepe and smoked sheet has been narrowed down to one penny per pound of rubber. This reduction should not, however, be considered alone. In the first place the cost of producing smoked sheet rubber is less than that of crepe; secondly, there is a slight increase in weight due

to the process of smoking to which the rubber is subjected. This second point is not always given full consideration. We have been told by Mr. Morrison and Mr. Williams, who admittedly manage business and technological departments respectively in two successful rubber manufacturing concerns in this country, that they have no preference for smoked as against unsmoked sheet. They both preferred sheet to crepe. Mr. Williams has given a definite statement to the effect that his preference for unsmoked as against smoked plantation sheet was based on the fact that the smoked variety showed an increase in washing loss and resin content.

These deliberate statements from manufacturing interests, like many others bearing on the values of different types of plantation rubber, seem to be at considerable variance with the daily market. Smoked sheets have always realized top prices during the present year. Granting that most of the material of this type is only superficially smoked, we cannot help thinking that the constituents of the smoke must exert some antiseptic influence which minimizes the risk during storage, and leads to a general improvement in quality. Otherwise one must admit that the price is entirely artificial and maintained by forward contracts and the willingness of growers to sell their unsmoked sheets at a discount.

We are quite convinced that no grower can at present sell forward unsmoked ribbed sheets at the same price as the smoked type. Yet the statements of the gentlemen named would lead one to imagine that business should result on those lines. The point is well worth serious consideration, since the smoking of rubber on plantations is costly and has very seriously raised the insurance of premium for rubber while in course of preparation. We feel sure that every grower would gladly abandon the smoking process if prices and qualities would not suffer. We suggest that some growers might try the market with lots of unsmoked ribbed sheets. The opposition of the market might be overcome in due course and estates ultimately saved an item of expense.—India Rubber Journal.

TAPPING HEVEA RUBBER IN UGANDA.

The following paper, written by Mr. E. Brown, Kivuvu, was read at the meeting of the Uganda Planters' Association on Saturday last on the subject of Rubber Tapping :—

The experiment of which I give the results was conducted during 1914. A total of 6,000 trees was tapped. The period of tapping covered 7 months. The trees varied in age from 4½ to 8 years from seed. The minimum girth at which tapping was commenced was 16 ins. at 8 ins. from the ground, and the trees varied from this girth to 30 ins.

Of the 6,000 trees, 3,000 were tapped for the first time, having just reached the tapping limit. The remaining 3,000 reached the tapping stage, and were tapped in 1913.

The basal V system of tapping was adopted, all the new trees having one V only, or on small trees only one side of the V cut. The older trees had two or even three V's, one above the other at 18 in. intervals. One quarter section of the girth was worked. Alternate day tapping was adopted

chiefly, but on some areas daily tapping was carried out for part of the time as an experiment.

The result in dry rubber was 8 ozs. per tree for the 7 months' tapping.

The cost of the rubber worked out as follows :

	Cost per pound.
Upkeep of area	25·6 cents.
Tapping	19·0 ,,
Curing and packing... ...	4·6 ,,
Upkeep of tools	1·0 ,,
Cost on estate ... ... say 8½*d.* per lb.	50·2 cents.
Freight to Coast	7·5 ,,
From Coast to London ...	3·0 ,,
Management	6·0 ,,
Total landed in London ... say 11¼*d.* per lb.	66·7 cents.

This cost compares very favourably with the cost of Eastern rubber as put on the market. In fact I think I am safe in saying that there are not half a dozen companies who do it cheaper. Naturally, when the trees are older and give double the yield they now give, costs will be materially reduced.

The grades of rubber worked out as follows :

First grade *72%*. Second grade and scrap *28%*. Here again the result is not far behind the East, for there if 75% of the output is top grade it is considered satisfactory.

The intervals of tapping have an important effect on the results obtained both as regards yield per tree and the cost per pound of rubber. To obtain the maximum yield per tree it is necessary to sacrifice cheapness per pound of rubber. To test this I tapped certain areas daily instead of on alternate days. These areas gave 1½ times the rubber per month that the other areas gave, proving that a higher yield per tree will be given by daily tapping. To get 1½ times as much rubber, however, the cost of tapping was doubled so that the cost of the greater yield worked out at 25% higher.

Other points against daily tapping are that it results in a much higher percentage of scrap rubber, there being double the bark parings to only 1½ times the latex. Also the tapping areas will last only half the time.

The Eastern plantations have found that the best results are obtained by working for cheaper rubber, by endeavouring to increase the yield per tapper, at the cost of a low yield per tree, and there seems little doubt of the soundness of this view. They, however, to a great extent, still stick to daily tapping, and reduce the number of cuts per tree to enable the tapper to deal with a larger number of trees. My plan is merely a modification of theirs for both result in a lighter tapping of the tree to get the maximum yield per cut.

The results I have obtained seem small compared to the yield given by trees even in this country, but it should be remembered that my experiment was on a commercial scale. Experiments on a very small number of trees are very valuable when a larger experiment is not possible, but the result

should be discarded as soon as the larger experiment is possible. The small experiments are likely to receive too much supervision and extraordinary care, with the result that the results are not secured when done more practically. Tapping experiments have been carried out in the country in recent years but generally with the object of proving the tree to yield a certain number of ounces. My experiment has been an attempt to prove that the tree will yield rubber at a cost that renders its collection a commercial possibility.

I trust that the figures I have given will result in the members of this Association giving more serious attention to rubber. Owing to the drop from the very high prices of the boom years, present prices are considered by many to mean that rubber could never be made to pay. Yet a product costing 1*s.* to produce and selling for 2*s.* cannot, after all, be called low-priced. It means a profit of 50% of the gross returns. Coffee does not give more than that. It is necessary for us to adopt a different standpoint regarding rubber, to keep from our minds the very high prices which have ruled, for of course, comparatively, present prices are low, and to consider fairly whether present prices can be made to pay. One finds it impossible nowadays to discuss the prospects of rubber without hearing of the great drop in its price. This fact seems to have so overshadowed rubber that it never gets a chance now, yet it was a commercial success before the boom rushed up the price of it.

To show that rubber selling at the present price pays, we have only to study the balance sheets of rubber companies in Malaya. Many pay 20, 40, and even 80% dividends even now. The question is, can we put rubber on the market as good and as cheaply as they? I have tried to prove that we can.—

The Uganda Herald.

IS ONE TAPPING CUT SUFFICIENT?

It is common knowledge that a few years ago it was customary to tap Hevea trees by a large number of incisions at least on one side of each tree. Nowadays it is fashionable to have one cut on one side only, the contention being that the yield of rubber therefrom is equal to that obtainable from a larger number of incisions. Frankly, we believe the latest development to be the natural consequence of over-tapping in the past. We do not believe that one tapping line a few inches long can draw the maximum quantity of rubber from Hevea trees, even when the latter are only forty feet in height. The anatomical characteristics of the laticiferous tissue in this typical forest tree are such as to make it impossible for one slanting cut to drain effectively the rubber from the whole of the bark on even the smallest specimen.

We admit that the fewer the tapping lines on each tree the better for the plant. Every incision, no matter how shallow, adversely affects the tree. But when rubber has to be obtained by making incisions in the bark one must be prepared to work on some plan which makes allowance for the age and vigour of the tapped trees. In the past, it is true, many young and old trees had each more than half-a-dozen tapping lines. Now it is suggested that each tree shall only have one tapping cut, mainly because the trees have,

in consequence of over tapping, begun to show a decline in yielding capacities. We do not doubt that even one cut on badly-tapped old trees will be too drastic.

If in the course of experience it has been found that one cut on a small tree is all that should be made, it does not by any means follow that the same is desirable or necessary for older trees. We believe that Hevea trees are first tapped at too early an age, and therefore agree that one cut should suffice for the first year or so of tapping. In later years we think that the same trees can stand two and even three cuts each.

We think this view will be appreciated when the trees now receiving only one cut each are a few years older. Most of the old trees of to-day were first tapped when they were only eighteen inches in girth, and have already had all their primary bark destroyed. In fact, on many trees the secondary and tertiary barks have been consumed at too rapid a rate, and one can only express surprise that they continue to yield good rubber. The young trees now coming into tapping round will receive much more gentle treatment than their parents, and should be able to give a better account of themselves when subjected to the knife in years to come.—India Rubber Journal.

The Chemist and Druggist (March 27th), referring to the antiseptic action of essential oils, makes special mention of Cinnamon oil, which is said to have proved "very efficient in preventing the growth of micro-organisms." It is suggested that soldiers at the front might be provided, for the instantaneous treatment of wounds, with collapsible tubes of ointment containing essential oil-such as Cinnamons which are more powerful than carbolic acid. It would of course be necessary to ascertain by clinical experience the limit of toleration of these ointments. It is stated that Eucalyptus oil does not interfere with the growth of micro-organisms.

Cocoa keeps steady, but the last auctions were not patronised to the extent of th ir predecessors; prices after a brisk opening failed to maintain any advantage, Ceylon being the exception to the general rule, which is not to be wondered at considering that Ceylon Cocoa had offered cheaper than any others for some time past, and the quality is turning out exceedingly good; however, the private market is now firmer than ever, and values are further enhanced, especially in the case of Summer Arriba, of which there is now only a small quantity offering, and so far as holders are concerned you can either pay the price or leave it.—London Commercial Record.

Says the Journal of the Department of Agriculture, Ireland, in its February issue:—"The linen manufacturing industry has now to face the most serious crisis in its history, brought about by the stoppage of supplies of flax from Continental countries as a result of the present war. Unless arrangements can be made at once for bringing in supplies of flax from Russia, very serious stoppage of machinery must result to the mills and factories in the North of Ireland." Flax is grown to some extent in India and its cultivation is being tried in Ceylon by the Agricultural Society.

CACAO.

CACAO AT PERADENIYA EXPERIMENT STATION.

The crop sold for the year April 1914 to March 1915 is as follows for 38 acres :—

Good cacao	240 cwt:	average per acre	6 cwt.
Black and Sweepings	59 ,,	do	1½ ..
Total crop sold	299 ,,	do	7½ ..
Average price good cacao		Rs.	47 per cwt.
Do black do		,,	21 ..
The highest price (April 1915 , being		,,	60 ..

This is a higher average than last year. These are the old trees that never received proper attention when they were young and were allowed to get into such a bad state of cultivation and disease as to be only yielding 2 cwt. per acre. They have not been manured for three years.

The results of the plots under experiment will be published as soon as possible.

All plots were well pruned in March, and all dead trees and those crowded have been removed and a new census taken of the number and varieties in each plot. The trees are now (April) bearing very heavy blossom in consequence.—Progress Report.

D. S. CORLETT.

THE QUALITIES OF CACAO DESIRED BY MANUFACTURERS.

H. P. BOOTH AND A. W. KNAPP.

It is by no means easy to make a definite statement which is generally applicable, because the various manufacturers look for different qualities, and cacaos from certain districts are prized for special purposes. There is, further, some danger in describing a desirable appearance, for it is not the appearance that is wanted, but the qualities that are associated with it.

In general, we believe that if the planter only allows ripe pods to be gathered, ferments for a reasonable period, cures with care, and keeps the beans dry, they will have the right appearance, and that he will be producing the best that the types of trees on his plantation will produce. It is evident from this statement that the value of claying and dancing is called in question.

We understand that *unfermented* cacao finds purchasers, but fermented cacao always obtains the higher price ; unfermented beans are more difficult to shell, and they produce an inferior cocoa. Partially fermented beans suffer from the same defects. With over-fermented beans the shell may

become so loose as to be fractured in carriage and handling. This opens the way for attack by grubs and moulds. This danger may also be incurred : (1) with over-ripe beans in which the germ penetrates the shell ; (2) by washing, which leaves the shell tender ; and (3) by lack of care in curing.

Cacao may be spoilt by not observing conditions of cleanliness during fermentation, or by exposing to bad odours. On curing these defects may be hidden, only to be revealed again on roasting, when the objectionable "hammy" or other flavour is developed.

Other objectionable features are the presence of twig-like pieces of dried pulp and placenta, and of small flat beans.

Criollo cacao contains a higher price Forastero or Calabacillo, because, while it is the rarest, it is a valuable ingredient of good chocolate. Large beans are preferred because they have a lower percentage of shell than small beans.

Probably the most highly appreciated quality is constancy or reliability of quality. A cacao which varies from bag to bag, or from time to time, will get little appreciation. Under ideal conditions standard qualities would be put on the market. Criollo, Forastero, Calabacillo would be fermented separately, and the beans graded according to size. Such a procedure would only be practicable where the cacao from several plantations was taken to a central fermenting station. At the present time we are far from this. Indeed, instead of a careful grading of good qualities, there is in practice a mixing of good and bad. Thus merchants buy cacao which they know to be diseased or unfermented, and deliberately mix it with good cacao. Such an action may not seriously affect the price of that particular lot, but it affects detrimentally the reputation of the cacao from that district, and the manufacturer regards that cacao as less desirable.

It is to be regretted that in some places cacao is still taken to the steamer in surf boats. Well-prepared cacao thus becomes wet with sea-water, and may later be spoilt by mould.

S. H. DAVIES.,
(of Messrs. Rowntree & Co.)

An immense amount of nonsense has been written on the fermentation of cocoa, but we know that the actual principles which underlie the fermentation of cocoa are extremely simple. It is exactly like the fermentation of any fruit. In the first few hours of fermentation you have the organisms which are found on the pod at the time they are cut down ; these are known locally as wild yeasts, and they grow first. Then their place is taken by a true yeast, which gives rise to a very large amount of alcohol. That is finally replaced by other organisms, and specially by an organism which is brought to the pods by the vinegar fly. Bearing this in mind, I think, with every respect to my distinguished French colleague who spoke of replacing fermentation by sterilization by steam, that the latter would not effect all the objects gained by fermentation. In fermentation in a close mass you have the products percolating all the time through the skin, and modifying the cocoa. It is true that with sterilization, if you allow plenty of air to play on the cocoa, you can do all that is necessary in the way of changing the violet or slate-coloured bean to a brown or red bean, but you do not get the products of alcoholic and acetic fermentation percolating into the bean. I think that we are now rather at the parting of the ways ; it is being suggested on many

hands that it would be well to do away with fermentation and to replace it by immediate drying, but these methods are not in themselves sufficient entirely, to replace fermentation, and will not give the same results. At the same time if I were a Gold Coast planter I should not ferment my cocoa, because the difference in price is so extremely small. It is, I think, the fact that you can dry the fermented beans to a very much greater extent than the unfermented, and if any of you carry out quantitative determinations on cocoa estates you will find it absolutely true that a considerable and unrealized loss of weight takes place, andthat is why, with every wish in the world to do so. I cannot honestly recommend that every man should necessarily ferment his cocoa. It is extremely unfortunate that, owing to causes I cannot go into here, the prices of different grades have drawn together, and now there is a very small difference in price between the good and bad qualities. I think if I were a planter and had steam available I should adopt Professor Perrot's method. I would steam the beans, and subject them to a temperature not exceeding 140° F., and so get a brown or a red bean, and at the same time gain something in the way of a pleasant flavour.—Proceedings of the Third International Congress of Tropical Agriculture.

MANGROVE BARK.

A Note on the Mangrove Forests of British India, by R. S. Pearson, F.L.S., (Calcutta: Superintendent, Government Printing, 1914), discusses the possibility of utilising Indian mangrove bark commercially. Up to the present this tanning material has not been exported from India to Europe on a commercial scale, although large quantities are annually imported into Calcutta from the Sunderbans, and on a smaller scale into Rangoon and Moulmein from the coastal forests of British Burma.

The most important mangroves found in British India are *Rhizophora mucronata*, Lamk., *R. conjugata*, Linn., *Ceriops Candolleana*, Arn., *C. Roxburghiana*, Arn., *Kandelia Rheedii*, W and A., and *Bruguiera gymnorrhiza*, Lam., while the largest forests are situated on the Arakan and South Tenasserim coasts, the Sunderbans, Andaman Islands, and to a less extent on the Bassein coast of British Burma.

Information is furnished as to the cost of collection of the bark, the quantities available, suitable localities for factories, labour, and local conditions. The Arakan and South Tenasserim districts are considered the two most promising areas available for the collection of the bark and its manufacture into a tanning extract in British India. The author states that the possibilities of utilising these mangrove barks commercially for tanning extract are fair to good, according to the locality selected.—Imperial Institute Bulletin.

HIGH YIELD OF FRUIT.

American Fruits gives some remarkable yields that have recently come under notice. In North Spy an apple grower picked 60 bushels of apples from one tree last season. The same journal states that an orange tree may produce 20,000 fruits but that lemons are less prolific, seldom yielding over 2,000.

TEA.

THE TEA MARKET.

Such a market as that experienced for tea during the present year has been unprecedented in the history of the trade. Buyers have been most anxious to operate, and the market has constantly been put up against them. The demand has slackened off with the approach of the holidays, but this is believed to be only a temporary emergency. It is probable that after the holidays the prices may again show an upward tendency. Common tea is nearly 3*d*. per lb. dearer than at this time last year. The present position is one where quality is ignored, everything is subordinate to the question of price, and attention is concentrated on the lower grades. Teas are selling above the level of the commoner sorts that in ordinary times would be worth several pence per lb. more money. The future course of the market is difficult to prognosticate, as so many events have still to be solved. There is the question of duty, whether the import will be raised to 1*s*. per lb., which is the view entertained in some quarters ; also there is the matter of export demand, whether the trade for Russia will come on as is expected when the Dardanelles are opened. The suppression of the sale of vodka in Russia, also the stopping of the trade in absinthe and other spirits in France, have helped to increase the demand for tea in these countries. Business has been very awkward this year, owing to the delays in deliveries from the docks, which have caused great inconvenience to the trade as a body. Matters do not look like improving, as, while there is plenty of tea here, shipments from India have dwindled almost to nothing, as is usual at the close of the season. There is also a great shortage of tonnage in the East, and shipments from Ceylon are likely to be retarded for some time to come. The situation for tea is full of possibilities, but supply and demand must after all be the determining factors as regards the future course of the market.—London Commercial Record.

THE BOOM IN TEA.

Several factors have contributed to an increased consumption of tea, huge quantities of which have been taken out of bond during the present month.

The amounts released do not altogether indicate the volume of immediate requirements, great as this is, for stocks have been shifted and duty paid, so as to be on the safe side in the event of further war taxes. All the same, the figures are significant, reaching record proportions.

The tea taken out of bond in the first 15 working days of March totalled no less than 25,179,588 lb., as compared with 14,076,852 lb. for the first 14 working days of the previous March. That is to say, a year ago tea was poured out of bond at the rate of one million pounds daily ; and the outflow latterly has been, broadly, on a daily scale of upwards of 1½ million pounds

Of the 25 million lb. 21½ millions have been earmarked for home consumption and 3½ millions for export, while 12 months back nearly 12 million lb. were allotted to home consumption and two million lb. or so to export. Though a dividing line may not be drawn with exactitude between the quantities of teas absorbed by immediate necessities and the balance of stocks which have been transferred from bond on grounds of expediency, the evidences of growing sales are none the less notable.

A RIVAL TO BEER.

Tea is more in demand as a rival to beer, though both have to bear a war tax, the curtailment of licensing hours having naturally a bearing on the situation; there is a consistently large despatch of tea at fixed periods for troops on active service; and then the position of the soldier's wife who is drawing a separation allowance with clockwork regularity makes for increased purchase of tea for her home.

WHERE TRUE ECONOMY LIES.

In this connection point may be made of a fact which is often overlooked. Whatever the quality of the tea purchased, and whatever the price paid, the duty per lb. is always the same. It stands at 8*d*. as 11 years ago, and the housekeeper who goes in for a low price article obviously has to contribute a higher percentage of duty.

Suppose, for example, that a customer obtained a tea at 1*s*. 4*d*. per lb., the result would be that out of every 4*d*. paid for the ¼ lb. 2*d*. would go to duty and the remaining 2*d*. would represent the money actually to be set against the value of the tea.

The price mentioned is not a trading figure, and yet even on a public body the argument has been pressed to the contrary, ignoring the effect of the added war charge. It is held by experts to have been a false move advancing tea by only 2*d*. per lb. when there was the extra 3*d*. duty; and though this may not at first glance seem acceptable to the careful housewife, the argument strengthens as it points the direction in which true economy lies.

The low price tends to the detriment of quality, which has to be reduced to furnish an article at the figure—though at the outset the public were ready to pay extra 3*d*. The man in the street gets a wrong impression regarding the apparently cheap tea for which prices have been forced down—and quality as well—overlooking the fact that material is often used for reducing purposes which in normal times people would not drink. That is not good for the customer or the trade.

MISTAKEN "CHEAPNESS."

Why buy common tea? It is not cheap, but really dearer than a fine 2*s*. tea, which at the present time is cited as a good basis.

In comparison with previous years, allowance has always to be made for the additional tax now imposed; and when it is demonstrated that the 2*s*. article will yield 280 afternoon cups of tea, whilst the lower grades will furnish only 220 cups, it is obvious that the better article is the cheaper, affording greater value for money.

The comparison of cost per 20 cups may be put as follows :—

Tea.	Cost of 20 cups.
1*s.* 8*d.* per lb.	1·78 (234 cups to the lb.)
2*s.* 0*d.* ,,	1·70 (280 ,, ,,)
2*s.* 6*d.* ,,	2·14 ,, ,,

"As to the differences in quality between the fine and the common teas, let people try a test for themselves," says an expert. Let those who have been satisfied with the lower grade try a pound of the 2*s.* 4*d.* article and then revert to the other : they will never take to that other again. We have found by practice that the fine article will always produce more tea than the common grades."

Scientific data supports the judgment of tea experts in distinguishing fine teas from the common types and in fixing their value and character ; and, moreover, it has been scientifically demonstrated that the finer teas supply better value because of what they contain of the actual essentials of tea in good proportions compared with cheaper sorts. The economy of using strong rich tea rules out the conventional spoonful measurement as applicable to all descriptions ; less need be used where there is the advantage in strength and quality that helps to narrow differences in outlay, which come to the veriest trifle in the weekly domestic budget.

All this points the moral of judicious selection at reasonable prices ; and with this is coupled the warning, voiced by experts, that business in teas reduced in quality to face an inequitable selling rate must have in the long run a damaging effect on the public consumption of teas.

RUSSIA AS A CUSTOMER.

It is on the finer teas that those best qualified to express an opinion base their faith, in looking for a still greater expansion of business, both at home and abroad. The home consumption has grown steadily for the past ten years ; and amongst countries which offer scope for enterprise Russia may be mentioned.

Already a large tea consumer, Russia will probably be a still bigger buyer now that a substitute has to be found for the banned vodka, and any accession of business in that direction may send tea to higher prices.

However, that does not immediately touch the market, in which the indications are in the direction of continued firmness. Nothing new is to be said at the moment as to the prospects of supplies, and the cautious man hesitates at this juncture to point to the outlook concerning coming crops.

—The Produce Markets' Review.

TOBACCO.

DUMBARA LEAF.

The following report on some Dumbara Tobacco sent by Messrs. Freudenberg & Co., to the Rubber Exhibition held last year at the Royal Agricultural Hall, London, has been received from the Imperial Institute :—

The sample received at the Imperial Institute consisted of 24 hands of tobacco each containing about 30 leaves. The leaves were in a rather dry condition, and many had become badly torn.

The material represented a cigar type of tobacco, varying in colour from greyish-brown to reddish-brown with a predominating reddish tint. The leaves measured from about 7 by 3 inches to 14 by 7 inches and were of thin texture. The toughness was variable, but on the whole rather poor.

The tobacco took fire easily and held fire well, leaving a pale grey ash.

The leaves as received bore stalks two or three inches long, which would require to be cut off (or "butted") if the tobacco were exported to Europe.

RESULTS OF EXAMINATION EXPRESSED ON MATERIAL AS RECEIVED.

Moisture per cent.	...	12·1
Nicotine ,,	...	2·1
Nitrogen ,,	...	2·4
Ash ,,	...	18·64
The ash contained		
Lime ...	Ca 0 per cent.	20·38
Magnesia ...	Mg0 ,,	7·80
Potash ...	K_2O ,,	23·53
Soda ...	Na_2O ,,	1·95
Sulphates, expressed as sulphuric acid	SO_3 ,,	2·00
Chlorides, expressed as chlorine ...	Cl ,,	3·60

COMMERCIAL VALUATION AND REMARKS.

The tobacco was submitted to three firms of manufacturers, who were unanimously of opinion that it would not be saleable at good prices in the United Kingdom unless it could be improved in certain respects. The burning quality was regarded as good, and the flavour of the smoke produced on burning was described as pleasant, though rather "dry" and "strong."

One firm only gave a provisional valuation of the tobacco, stating that if it could be produced longer and broader in the leaf and was exported in

good clean condition with the "butts" or ends of the leaves removed, it might be worth 5*d.* to 6*d.* per lb. in the United Kingdom as a cigar leaf tobacco.

Four cigars made entirely of the Ceylon tobacco, and four made of Borneo wrapper, with Cuban and Ceylon filler in equal proportions, are forwarded for reference. The cigars made from the Ceylon leaf alone are of an unusual reddish-brown colour, but they burn well, hold fire well, and leave a pale, fairly coherent ash. The aroma and flavour of the smoke are peculiar and a little pungent, but not unpleasant.

The "blended" cigars, made of Ceylon and Cuban filler with Borneo wrapper, are of better flavour and aroma when smoked, but the peculiar character of the Ceylon tobacco is still noticeable.

GENERAL REMARKS.

In an article published in the Bulletin of the Imperial Institute, Vol. X. (1912) pp. 187-205, the tobacco industry of Ceylon is discussed in detail, and the results are given of the examination of a number of native-grown tobaccos, and also of tobaccos grown under European supervision in Ceylon. It was pointed out in that article (p. 201) that the commercial value of cigar tobacco depends mainly on two factors: (1) its composition and (2) its appearance and texture. The former determines its burning quality and the aroma and flavour produced on smoking, and the second the particular purpose to which the tobacco can be applied in cigar manufacture.

The composition of the present sample is satisfactory, and in certain respects it is better than that of any tobacco from Ceylon previously examined at the Imperial Institute. Reference may especially be made to the large proportion of potash, and to the relatively small quantities of the undesirable constituents, chlorides and sulphates, in the ash. This accounts for the good burning quality of the tobacco.

The defects of the tobacco are almost wholly physical: it is of bad shape, size and colour, and these defects are due to unsatisfactory cultivation and fermentation. As regards shape and size British manufacturers are not unreasonable in their requirements, since they are willing to buy tobaccos from Japan, Java and Sumatra, all of which show considerable variations from one another in these respects. It is, however, desirable that tobacco from a new country should either conform in size and shape with kinds already in use, or at least be of such a size and shape as will permit of economical working for cigar manufacture. These are matters on which the advice of the Government Tobacco Expert in Ceylon is essential to growers.

The colour of the tobacco is also an important point, and it may be modified suitably in the fermentation stage of the production. To a certain extent the colour required for cigar tobacco in Europe is a matter of fashion, and on this point also the Government Tobacco Expert will be able to assist growers.

Some of the tobacco contained a good deal of dirt and sand. This is a matter which can easily be remedied by clean cultivation and handling. Finally, it should be pointed out that for export to a country like the United

Kingdom, where the duty on tobacco is high, it is essential that the useless "butts" or stalks of the leaves should always be cut off before shipment.

On the whole the results of examination of the present sample of tobacco confirm the opinion expressed by the Imperial Institute in previous reports on Ceylon tobacco and cigars (see especially the Imperial Institute reports of the 4th January and 16th November, 1911, and that of the 27th November, 1914), that with expert assistance in the cultivation and fermentation it should be possible to grow cigar tobacco of high grade in Ceylon.

TOBACCO IN THE EMPIRE.

There is a prospect of considerable encouragement being afforded to the wider cultivation of tobacco of the American type in the British Colonies. Nyassaland, Rhodesia, and more recently Canada, are increasingly producing tobacco which is rapidly finding favour in the United Kingdom. The evidence given before the Royal Dominions Commissioners shows that very favourable conditions and considerable resources exist in various parts of the Empire—awaiting development. The presence of large contingents from the Dominions among the forces soon to be in the field, the fine quality of the produce hitherto grown, and the possibilities arising out of the war, have prompted action on the part of the Imperial Institute which has met with ready and favourable response from Lord Kitchener. Colonial tobaccos have not hitherto been included in War Office specifications ; but as a result of this appeal the Secretary for War has now modified War Office conditions so as to enable satisfactory qualities grown in the Colonies and Protectorates to be utilised for the service of the troops if the tenders are satisfactory. Unfortunately, however, Rhodesian tobacco, which has an assured place in the European market, has not found official favour. It is to be regretted if a short-sighted desire to effect a trifling economy is the reason for this, for Rhodesia has earned a right to expect sympathy and encouragement.—United Empire.

RAINFALL FOR APRIL 1915.

Place	1915	1914	Place.	1915	1914.
	in.	in.		in.	in.
Colombo	4·71	3·78	Kurunegala	7·91	5·77
Kandy	10·47	4·10	Batticaloa	1·19	·92
Galle	3·00	10·57	Badulla	6·18	7·05
Jaffna	1·64	1·15	Ratnapura	6·55	8·39
Anuradhapura	9·98	3·75	Nuwara Eliya	4·15	2·33

SUGAR CANE.

CANE TOPS FOR PLANTING.

ARTHUR H. ROSENFELD.

It has already been proved at various times that the higher part of the sugar cane germinates better than the lower part, while it is also common knowledge amongst those interested in the making of sugar that this higher part of the cane contains a juice of less purity. In other words one may say that, generally, on cutting any cane into pieces of two or three nodes each, and extracting and analyzing the juice of each piece under equal conditions, one will find that the purity of the juice diminishes the nearer one approaches to the top of the cane. The custom, therefore, practised in many sugar countries—notably in Hawaii and Java—of only planting the tops of canes appears very logical.

By this method a juice is secured in the factory which on account of its high purity renders the work of the defecation, clarification and evaporation processes comparatively easy, while planting is done with the cane that is usually flung aside as worthless.

In Tucuman, as in Louisiana, it is the practice to plant whole canes, and it has frequently occurred to the author of this article that this practice might very beneficially be replaced by the custom employed in other countries of using for planting purposes the parts of the cane which are usually discarded as useless. The old method entails the planting of 10 tons of sound cane, cut at the first white joint, per hectare. This represents an outlay of $25 United States gold per acre, according to the average price of cane in the Province. This method also conduces to the degeneration of the cane fields, in that the planter is induced to sell his best cane and use inferior and diseased canes for seed in place of sound ones.

We resolved, therefore, in the winter of 1911, to make a thorough investigation of the matter. A piece of land was chosen in June and ploughed with an ordinary share plough, followed by a sub-soil plough. The plot was then harrowed with a tooth-harrow, reploughed with a 26-inch disc plough, and harrowed again. About the middle of July the rows were marked out with a small share plough and deepened with a cleaning plough. Half of the lot was then planted with ordinary native cane, and the other half with cane tops taken from a consignment of leaves and tops used for feeding animals which had been received from one of the factories. The rows were afterwards covered with a small share plough.

The idea of selecting the tops from the consignment for use as food for animals was not adopted as the most practical method, but merely because an extremely drastic comparison would be furnished, due to the fact that the tops planted were undoubtedly those usually considered useless. The cane was irrigated on the following dates: 15th of July, 5th and 20th of November.

On the 6th of October the cane was cultivated with a large four-share cultivator (shares pointing inwards) passing twice in each row. In the middle of the same month the rows were weeded and dirt thrown to the cane. On the 21st of October the cultivation of the 6th was repeated and the rows were weeded by spades. At the end of December the weeding was repeated and the cane was fertilized with a mixture composed of 50 per cent. dried blood, 40 per cent. superphosphate of lime and 10 per cent. sulphate of potash, applied in the proportion of 600 kilos per hectare. The fertilizer was thrown by hand and lightly covered afterwards with a small share plough. The plot was then cultivated with the large four-share cultivator (shares pointing outwards) and some dirt was thrown to the cane with the six-disc machine. This cultivation was repeated at the end of January, save that the four-share machine passed only once. The cultivation of the plot was concluded about the middle of February by passing once with a five-tooth harrow drawn by one mule The cane was harvested in the middle of July, 1912.

In August, 1912, there was no rain and in September only 10 mms. As it was also impossible to irrigate the cane in these months owing to lack of water, the thinner tops planted naturally dried up to a large extent. There is no doubt that had we been able to irrigate, or had more rain fallen during the months mentioned, a much better germination from the tops would have been secured. Naturally, the whole canes did not dry so easily owing to the smaller surface exposed to evaporation and to the hardness of the lower epidermis.

Table I gives the results of the harvest :

TABLE I.

HARVEST OF PLANT CANE.

Lot Planted with	Kilos of Cane Per Hectare.	Average weight Stalk. Kilos.
Cane tops ...	21,371	0·52
Ordinary Canes...	29,066	0·57

The results of the first year were not very favourable to the new system of obtaining seed. Nevertheless, for the reasons mentioned above (the dryness of the season following the planting), and to avoid forming too hasty an opinion in the matter, we decided to extend the experiment to stubble cane.

As stubble cane, the lots received the following treatment :—September 26th, 1912, the cane was off-barred by passing a share plough twice down the middles and once at each side of the row close to the cane. No spade work was done.

October 5th, 1912, the lots were irrigated.

November, 1st, 1912, the lots were irrigated.

November, 6th, 1912, the cane was fertilized in the same manner as during the previous year.

November 22nd, 1912, the large four-share (pointing inwards) cultivator was passed twice down the middles.

December. 12th, 1912, dirt was thrown to the rows by the large six-disc machine.

December 24th, 1912, the rows were weeded by spades.

December 26th, 1912, the middles were cultivated with the large four-share cultivator (shares pointing outwards) and as the middles were very weedy, a share plough was also passed twice.

January, 4th, 1913, dirt was thrown to the rows with the six-disc machine and the four-share cultivator was passed once down the middles.

January 22nd, 1913. The lots were irrigated.

June 24th, 1913, the cane was harvested.

The following table gives the results of the second year's harvest :

TABLE II.

RESULTS OF FIRST YEAR STUBBLE CANE.

Lot Planted with	Kilos of Cane per Hectare.	Average Weight Stalk. Kilos.
Cane tops ...	26,200	0·79
Ordinary Canes...	47,104	0·73

We find in this table that the production of both lots was greatly increased and that the tops gave nearly as much cane as the other lot, with a higher average weight per stalk. These results have inspired us to continue the experiment, planting the cane in August instead of early in July, and we hope to be able to irrigate whenever necessary.

The results of this second series of experiments will be published in due course.

It seems, at least, that this question merits every consideration, and we would advise planters to conduct investigations in their own fields so that a definite conclusion may be arrived at. Frequently from such investigations of seemingly small importance results of much benefit to the whole industry are obtained.—The Louisiana Planter and Sugar Manufacturer.

THE SUGAR PLANTING INDUSTRY.

H. T. EDWARDS.

It is supposed that the sugar cane (*Saccharum officinarum*) was originally found in India, probably in the region of the Ganges. There is no sugar cane known anywhere to-day in the wild state, although there are several species of mammoth grasses closely akin to this plant.

As various portions of the earth's surface were explored and finally settled the sugar industry was extended, until to-day one finds it flourishing in practically all tropical countries and many sub-tropical countries as well. Perhaps the last semi-tropical region to attempt this industry in a commercial way was the State of Arizona, U. S. A., where the desert wastes were turned into flourishing beet and cane fields by the aid of irrigation from the Government storage dam.

During the reign of Napoleon in France trade in the sugars from British and other foreign possessions was destroyed by the war with England, but this decline in the cane-sugar trade served only as an impetus to the new beet-sugar industry then being started. In the meantime there was such a dearth of sugar and such a fabulous rise in prices, that attempts were made to secure sugar from various plants and fruits growing in France, such as beet, sorghum, maize, grapes, apples, pears, figs, etc.

At that time the manufacture of a kind of sugar from grapes became quite important so that during the period from 1811 to 1813 considerable quantities of this class of sugar were made. Simultaneously with this new venture the beet root was gaining in importance year by year, especially in France, and to a certain extent as well in other European countries, until after extensive experiments in plant breeding it was learned that the sucrose value of the root could be very much improved. From this work varieties of beets used to-day have evolved, which often contain as high as 20 to 25 per cent. sucrose. Another obstacle in the way was the bad taste and odour of the low-grade sugars from the beets and the difficulty of making a high-grade sugar. To-day the heavy liming and the carbonation process give a sugar equal in all respects to the best grade of granulated cane sugar, and one finds a great deal of beet sugar either mixed with cane sugar or marketed alone under the name of cane sugar.

At the present time the beet-sugar industry has become so important that more than eight million tons, or about one-half of all the sugar produced, comes from this source.

There is a greater consumption of sugar each year, which necessitates greater production either through larger areas, heavier yields, or its manufacture from other sacchariferous plants. The maximum in both area and yield have by no means been reached, while in recent years a large number of sacchariferous plants have attracted the attention of various investigators throughout the sugar world, and this will in all probability lead to a new source of supply. The most promising of these plants is the sugar palm (*Arenga saccharifera*). Extensive work was conducted on this palm by this Bureau and reported in the May (1914) number of the Philippine Agricultural Review. During the above-mentioned year an entirely new method of juice clarification was elaborated which is applicable to the juices of various other palms as well as to that of the sugar cane.

In Bengal the wild date palm (*Phœnix silvestris*) has produced a low grade of molasses sugar for consumption by the natives for a great number of years. The main obstacle encountered in making a good grade of sugar from this palm has been caused by the difficulty of clarification and the susceptibility of the juice to fermentation. It is thought that the above-mentioned process may bring this palm into greater prominence in the sugar world.

There are also the Palmera (*Borassus flabelliformis*) of Southern India, and the Nipa (*Nipa fruticans*) of the Philippines. Either of these could undoubtedly be made profitable sugar producers. The latter is used commercially only as a source of alcohol.

There is practically no limit to the number of sacchariferous plants one might name in the tropics and sub-tropics, but many of these do not contain a sufficient percentage of sucrose, or else they contain such a high percentage of impurities that the low yield of sugar and the high cost of manufacture make their use unprofitable.—Philippine Agricultural Review.

SELECTION EXPERIMENTS WITH SUGAR CANE.

H. C. PRINSEN—GEERLIGS.

The Archief Voor de Suikerindustrie in Nederlandsch Indie contains a long article by Mr. Quintus, who relates the results of the experiments which he made for years on a Java sugar estate in order to judge of the merits of the different methods advocated for the improvement of the sugar cane by selection.

In the month of June, 1910, a great number of cane stalks from one sound and well-developed field were analyzed individually after the tops had been cut off first and carefully labelled. The sucrose contents of the different canes showed great variations; they were divided into two groups, the average sugar content in the juice of which was 11·95 and 15·58 respectively. The tops of these canes were planted in the same field in such a way that each time one plot of the tops of the rich canes alternated with those of the poor ones. The field was cultivated, manured and treated as usual till the canes were ripe, at which period daily 100 canes from each of the two groups were analyzed.

FIRST SERIES.

The total amount of stalks analyzed was 944 from the first and 1,047 cases from the second group, while great attention was paid to choose only well-grown and healthy canes for the analysis. The average polarization of the rich group was 19·4 , while that of the poor group was found to be 19·31. The original difference of 3·63 per cent. had, therefore, decreased to 0·13; there is difference, but too small to come into account for practical work.

Again tops were taken from the individual canes having the highest and the lowest sugar contents in both groups, so that now four portions were investigated, to wit: two from the original poor and two from the original rich group. The sugar contents were respectively 17·54 and 19·44, 17·85 and 20·76. The canes from these tops were again treated in the ordinary way and harvested a year later at the full time of maturity. The number of stalks analyzed from the first group was respectively 1,284 and 957, while those from the second group were 983 and 943. The average polarizations were this time 19·14, 19·22, 19·17, and 19·54, so that the original differences in this experiment have come down from 1·90 to 0·08 and from 2·61 to 0·37 —differences which lie between the errors allowable in field experiments.

The experiments were repeated with two other cane varieties. The poor group of the first polarized 17·08, the rich 20·08, where these figures were respectively 16·80 and 19·29 in the second one. A year later, the first variety showed in an average of 887 stalks of both groups, respectively, sugar contents of 19·79 and 19·64, thus showing that the original difference of 3 per cent. has dwindled down to a mere 0·15. The second variety, of which 760 stalks of poor and 768 stalks of the rich group have been analysed, gave polarizations of 19·69 and 12·74 per cent. In this case the original difference of 2·49 has come down to 0·05 per cent, a fraction which is certainly not worth consideration.

SECOND SERIES.

A second series of experiments was made with a view to ascertaining whether the weight or the diameter of cane stalks are hereditary in the usual way or propagation by cuttings. To that end a great number of tops divided over four varieties were cut at the same distance from the vegetation point, reduced to the same length and divided after their weight into four portions, all of which were kept apart and planted in the same field. At the moment in which the canes had attained their full growth, the diameter of the stalks was determined at 1 metre above the level of the soil. In two varieties there was no difference to be detected at all, in a third the scions of the heaviest tops were somewhat thicker, but in the fourth variety they were somewhat thinner than those of the lighter original stalks. The experiment was repeated by taking tops from the thinnest stalks out of the lightest group for the new group against the thickest ones from the heavy group, so that the average differences in diameter were as high as from 7 to 9 millimetres. The canes from this experiment at their full development were so very much alike in diameter, that also in this case every effort of getting a heavy cane variety by picking the heaviest canes for seed proved futile.

THIRD SERIES.

A third series of experiments touches the number of stalks per stool. A great number of stools were counted and those bearing the largest number of stalks separated from the rest. The average number of this rest was 6·2 stalks per stool, while that of the selected ones amounted to 9·4, or 3·2 more. The tops were planted and the cane manured as usual, while after the ripening period had set in the number of stalks to the stool was counted again. The number of stools participating in the experiment was 974 in the first, and 998 in the second group, or large enough to be relied upon, but the number of stalks per stool averaged in the first one 6·14 and in the second 6·32. In order to emphasise the difference, tops were taken from a number of stools bearing four stalks or less for one group and from stools with nine stalks or over for the second one, thus making the minimum difference five. The result again was that the average number of stalks to the stool in every one of the plot was so very much alike that the conclusion must be drawn leading to the utter uselessness of selecting sugar cane according to the sugar content, according to the weight of the cane and according to the number of stalks to the stool.

The differences in sugar content, or in thickness of the stem or in number of stalks to the stool is a consequence of outward circumstances which may make themselves still (be it to a much smaller amount) felt in the progeniture, but after a very few generations this influence has ceased, so that selection according to one or other of the criteria mentioned may produce a small effect in the first generation, as is distinctly shown by the experiments referred to, but this effect is not lasting and does not make good the trouble and expense devoted to it.

If it were possible to find out which circumstances induce a plant to obtain a high sucrose content, or a large diameter or a great number of stalks to the stool, we need not wait for a generation but, if we can expose our canes to those influences, we might profit from them at once and when doing so every year, we are sure of a good quality of the crop, even if the properties are not hereditary and have to be raised in every generation anew.

EXAMINATION OF RESULTS.

The different characteristics which according to the opinion of many planters account for the influence exerted on the cane were submitted to a close examination.

The first series of experiments related to the kind of stalk from which the top had been cut, that is to say, whether tops from the primary stalk give better cane than those cut from the secondary stalks of a stool.

Four criteria were examined in order to make out whether the primary stalk is more vigorous than the secondary ones, viz: the length of the stalks, their weight, the leaf surface and the sugar content. It resulted from the experiments that the difference in length is rather great in the beginning, but that it diminishes in proportion the relative ages as of the two kinds of stalks becomes more alike. After nine months the longest secondary stalk has already exceeded the length of the primary one and, calculated over a great number of tests, 16 per cent. of the secondary stalks are at that age longer than the primary ones. The average length of all the first stalks remains, however, always more than the average one of all the secondary cane stems.

The weight of the cane stalks is divided fairly in the same proportion as the length. The weight per unit of length does not differ perceptibly for the different kind of stalks and this leads to the conclusion that the proportion of weight closely follows that of the length.

The total surface of the leaves of the cane stalks is always larger in the case of the primary stems of the same stool than that of the secondary ones. The surface of the longest secondary ones is only at an age of nine months superior to that of the first stalks, but these figures are not absolutely sure, since it was found that the overshadowing of the highest leaves exerted a great influence on the development of the leaves placed under that shadow.

In the first months of their growth the so much older primary stalks possess a higher sugar content than the younger secondary canes, but as the canes grow older and the relative differences shrink, the differences in the sugar content shrink also, causing at the time of harvest no marked difference in the sugar content of the different stalks of one stool. That is to say, the different stalks show differences, but it is not always the primary one which is the best. It may be an average one or a good one or even a bad one, but there is nothing that could allow of the conclusion that a primary cane is the best, or the strongest and, therefore, it is immaterial whether the tops for the new crop be cut from primary or from secondary stalks.

Direct experiments made by planting cane from tops of the primary stalk of a cane in comparison with those from secondary ones, all of them stated to be so after the old plant had been dug out and inspected, showed, in some cases, that the former gave the best results and, in other, the latter were foremost, thus leaving no reason for preferring either of the two.

As experience teaches us that cane varieties having very thick or top-shaped joints possess an inferior juice than those having pure cylindrical and slender or tapering joints, it was tried whether in the same variety those tops which are best shaped would bring forth better quality plants than those of which the form resembles the objectionable varieties. A great number of tops were selected after the characteristics and planted in the same field

on plots placed together, but here also no distinct differences were able to be detected in the series, showing that also the form of the joints is immaterial in this respect The same thing was observed in the form of the uppermost joints. It had been observed that in the best stalks the upper joints were very short and close together and it might be that this characteristic was a good point of distinction between bad and good canes, but experiments demonstrated the vanity of that hope, and taking everything together we must come to the conclusion that the outward characteristics of the cane are as little worth for the selection as the specific gravity or the sugar content of the canes.

The results of the experiments made by Quintus fully agree with our own views expressed in our article of April 15th of this year, in which we showed the futility of attempting to raise permanently the sugar output of a variety of cane by selection based on one or more characteristic properties of the cane. The growth and the sugar content of canes of the same variety do not depend on hereditary properties but merely on conditions of soil, water manure, sunshine, and the like. A small after-effect of particularly favourable or unfavourable circumstance may be seen in the first generation but further than that no effect could be expected from chemical or optical selection of sugar cane propagated by cuttings.—The Louisiana Planter and Sugar Manufacturer.

PLANTAINS AT THE EXPERIMENT STATION, PERADENIYA.

The pink fungus (*Glœosporium musœ*) has attacked bunches of fruit, especially the Alu-kehel variety. When attacked the top hands die first and gradually the whole bunch dies. Spraying with Bordeaux mixture is being tried.

The leaf disease (*Fusarium*) still continues to spread in spite of cutting off and burning the affected leaves.

A beetle has also attacked the stems and killed many plants which have to be cut down and burnt to prevent the insect spreading,

It would, therefore, appear that plantains in Ceylon are subject to a variety of diseases and great care should be exercised in only planting suckers from healthy plantations and in exercising a sharp look-out for the first appearance of disease so that it may be checked in time.

So far the variety Hondarawalu seems the best suited to resist the attacks of both fungus and insect, as up to now it has not been infected from the neighbouring plants.

The bunches from the ratoons are proving considerably larger than those from the first plant, which is the reverse of that which happens in the West Indies, where the single parent plant is reckoned to bear a 9 or 10 hand bunch and the ratoons 8 to 6 hand. Here the average for first bunches of Hondarawalu is 9 hands, while the two ratoons are bearing bunches averaging 11 hands.—Progress Report.

D. S. CORLETT.

COFFEE.

ROBUSTA COFFEE.

P. J. WESTER.

When the blight appeared in Java coffee-growing was one of the most important industries in that island, and after the plantations had been destroyed by the disease, the Dutch Government, having failed to control the blight by repressive measures, instituted investigations with a view of discovering a blight-resistant coffee, in the course of which work several species were introduced and tested. Among these were Liberian coffee (*Coffea liberica*) and robusta coffee, considered by WILDEMAN to be a variety of *Coffea canephora*.

Robusta coffee was discovered in the Belgian Congo, and seeds were sent to Brussels, Belgium, and propagated, where plants were first offered for sale in 1911. Some of these plants found their way to Java. Like most new introductions the robusta coffee was at first looked upon rather askance, but as its greater climatological range as compared with that of Arabian coffee, and its productivity, precocity, and resistance to the coffee blight (*Hemileia vestatrix*) became apparent, it rapidly gained popularity—so rapidly in fact that the Javanese coffee plantations to-day consist almost entirely of robusta coffee. The fact that in 1909 the total crop of robusta coffee was only 183,000 kilograms, and that in 1911 9,650,000 kilograms were produced, with an estimated yield of 16,000,000 kilograms for 1912, and that during the period from 1907 to 1911, 24,521,000 robusta coffee plants were planted, is ample proof of its popularity in the Dutch East Indies

INTRODUCTION INTO THE PHILIPPINES.

Robusta coffee has not been introduced into the Philippines to any extent. Bearing trees are reported from Basilan, near Zamboanga, and a few plants are also growing at the Lamao experiment station in Batana. The latter are in good condition, with no indication of blight.

SOIL AND CLIMATE.

Robusta coffee grows well from sea level to an altitude of 1,000 meters, doing best at an elevation ranging from 450 to 750 meters.

Less particular than Arabian coffee, the robusta thrives well on both light and heavy soils provided they have the necessary fertility. However, good drainage is essential for a good growth, and therefore robusta should not be planted on sticky and very heavy, water-holding soils. Poor and sandy soils should also be avoided. This variety is also somewhat sensitive to drought and should be planted only where the rainfall is fairly evenly distributed, and where the dry season is of comparatively short duration. Generally speaking, where the soil conditions are favourable, the cacao, abáca, and coconut growing districts of the Archipelago are perhaps better adapted than other sections to the culture of robusta coffee.

THE NURSERY.

The place selected for seed bed and nursery should be well drained, with a loamy soil, the richer in humus the better. A light bamboo frame should be erected above the nursery plot about 2·5 meters high, and covered with grass or split bamboo to provide about half shade. The land should be spaded thoroughly to a depth of 30 centimeters, and all stones, roots, etc., removed. One meter is a convenient width for seed and plant beds.

The seeds should be sown broadcast, not too thick, covered with not more than 1 centimeter of earth, and then watered thoroughly. Hereafter the seed bed should be well watered from time to time whenever the soil appeared dry. Frequent light sprinklings that do not allow the water to penetrate more than a few millimeters below the surface are harmful rather than beneficial both in the seed bed and the nursery, in that they encourage a shallow root formation.

As soon as the first leaves are fully expanded the seedlings should be transplanted to the nursery beds, which should be prepared like the seed bed. If the land is poor it is well to spade in a liberal quantity of well-decayed manure or compost. The plants should be taken up carefully, the taproot nipped off with the thumb nail, and then transplanted with the aid of a pointed stick or small dibber, spacing them 10 to 15 centimeters apart each way. In doing this care should be taken that the roots are not doubled up in the hole and that the soil is well packed around them. More plants should never be removed at one time from the seed bed than can be conveniently transplanted before they show signs of wilting, and the dug plants should not be left exposed until the roots dry out. The plants should be thoroughly watered before and after transplanting, and beds kept free from weeds and watered as often as necessary.

CLEARING AND PLANTING.

Wherever possible, the land to be planted in coffee should be stumped, and ploughed once or twice, so that after the plants have been set out animal-drawn cultivators can be used to keep down the weeds. Thus the cost of weeding is lessened during the early years of the plantation while the plants are small. If ploughing is not feasible holes 1 meter in diameter and at least 30 centimeters deep should be grubbed where the plants are to be set.

On moderately rich land robusta coffee should be planted 2·1 meters apart each way, 2,265 plants to the hectare; on very fertile land the distance may be increased to 2·5 meters, 1,600 plants to the hectare.

Arabian coffee should be spaced from 2 to 2·5 meters apart, or on poor land even closer.—M.T.F.

When the plants are 4 to 5 months old they should be about 20 centimeters tall and ready for transplanting. About one-half of the foliage should now be cut off; a trench should be dug at the end of the nursery bed about 20 centimeters or more deep; then a thin, sharp spade or bolo (cutlass) should be passed through the soil, underneath and around the plant, neatly severing all straggling roots, and leaving the plant in the centre of a ball of earth. The plants should be set out in the field at the same depth at which they grew in the nursery, great care being taken not to break the ball. If the soil is so loose that it falls away from the roots in the removal from the nursery, great care should be exercised in not allowing the roots to dry out

and in setting out the plant so that the roots fall in a natural position. In the course of the planting the soil should be firmly packed about the roots.

The sowing of the seed in a given locality should be so timed that the plants are ready for the transplanting at the beginning of the rainy season in order to avoid the experience of artificial watering. If transplanted during the dry season the plants necessarily would have to be watered by hand from time to time until they are established.

PLANTS FOR SHADE.

As a temporary shade and cover crop of rapid growth while the coffee trees are small, perhaps, no plants can compete with the cadios (*Cajanus indicus*). The plants may be cut down to serve as mulch whenever they grow too high, and may be expected to grow from the stubble twice before the plants die, provided they are not cut off too close to the ground.

In Java, where robusta coffee is more extensively planted than anywhere else, permanent shade is considered advisable. Malaganit (*Leucaena glauca*), a leguminous shrub which grows everywhere in the Philippines, seems to be preferred there to other plants for shade. It is planted alternately with the coffee plants, and, as is the case with all plants utilized for shade, thinned out later according to need. Madre de cacao (*Gliricidia maculata* and dadap (*Erythrina indica* and *E. subumbrans*) are other leguminous trees readily obtainable in most localities and adapted for shade.

Madre de cacao should be planted at the same distance as the malaganit, while the dadap should be planted one plant to every two coffee trees. All these plants are readily propagated by cutting off limbs or branches 1 to 1·2 meters long and inserting them 20 to 30 centimeters deep in the ground during the rainy season. (This is most conveniently done by the aid of a crowbar). In a limited way fruit trees, such as the soursop, custard apple, breadfruit, and jak may also be used as shade, and these should be planted from 6 to 12 meters apart, according to size. The necessary shading between these trees while they are small may be provided by planting malaganit, etc.

Robusta coffee has also been successfully interplanted with coconuts. In this case the palms and coffee should of course be planted at the same time, the palms perhaps not closer than 9 to 10 meters apart, the coffee to be used as a "filler" between the coconuts. In this connection it is perhaps well to state that in Java robusta coffee is very frequently planted as a "catch crop" in the Hevea rubber plantations. Among the shade plants available to the Philippine planter, malaganit, dadap, and "guango," or raintree (*Pithecolobium saman*), have given the best results in Java for the robusta with the following ratio yield of coffee: 4·75, 4·10 and 3·06.

CULTIVATION.

On level and well-cleared land, close attention should be paid to keeping the coffee plantation free from weeds during the first year or two by means of animal-drawn shallow cultivators, supplemented with hand-hoeing. Where the topography of the land or the presence of stumps renders this impossible the weeding must of course be done by hand. All weeds should be left in the field where they serve both as a mulch in preserving the moisture and to enrich the soil. As soon as the plants begin to shade the land they thereby aid in the weed eradication, and weeding then becomes less expensive.

PRUNING.

If the trees are allowed to grow without pruning they become too tall (robusta coffee attains a height of 6 meters or more), and the topmost berries are then difficult to pick. Furthermore, unpruned coffee trees (including robusta), have the peculiar habit of bearing their branches near the ground and at the top, leaving the middle bare or nearly so, which decreases the producing capacity of the plant. On this account up to-date planters have generally adopted a system of pruning by which the coffee trees are headed low, giving a maximum yield coupled with easy access to the berries.

The pruning consists of topping the robusta trees when they are from 2 to 2·5 meters tall and of subsequent pruning to keep the trees at this height. This work should preferably be done while the plants are of the proper height and the green shoots easily broken off, and not after the trees have exceeded the height limit by several decimeters. The plant, if allowed to do so, usually sends up a large number of suckers from the base, which constitute a drain on the vitality of the plant. Therefore, all superfluous suckers should be removed and not more than 2 to 3 stems to a plant should be permitted to develop.

Occasionally robusta plants appear that are more than ordinarily subject to blight, and these should be at once pulled up and burned.

YIELD.

The yield of robusta coffee is quite variable, much depending upon the fertility of the soil. On the more fertile soils in Java the yield per hectare in the third year was approximately 540 kilograms, and in the fourth and fifth years, 1,400 and 1,830 kilograms, respectively. In old coffee or cacao fields the yields were 325, 540 and 850 kilograms per hectare, respectively, during the third, fourth and fifth years after planting. It is perhaps well to recall the fact that the average yield of Arabian coffee in the Philippines is 174 kilograms per hectare, which is of course much less than it should be, and it is not believed that the Philippine planter with his present methods of cultivation could equal with robusta coffee the yields quoted from Java.

The immense superiority of the robusta as a cropper over the ordinary Arabian coffee is best illustrated in a table published by the Department of Agriculture, Java. We learn here that in Java, under identical conditions, the yield per plant was of Quilloi (a new very rare coffee) 1,020 grams. The Maragogipe hybrid on its own roots yielded 14 to 18 grams, while grafted on robusta the yield was 156 grams, a larger crop than any Arabian coffee has given in Java. This would tend to show the possibilities of robusta as a stock. Further, comparative studies by Cramer have shown that 4 to 5 kilograms of fresh robusta berries make 1 kilogram of coffee, while of the Arabian coffee 5 to 6 kilograms of fruit are required to make 1 kilogram of coffee.

Owing to the fact that the pulp of the robusta coffee (though smaller in amount) is more difficult to remove than that on the Arabian, robusta needs at least two and a half days of fermentation. The bean requires rapid drying in order to loosen the silver skin and the drying is therefore done in an artificially heated shed.

QUALITY AND MARKETABILITY.

Relative to the quality of the robusta coffee Doctor Hall says:

The appearance of the average marketable robusta is not very beautiful; the beans are small and irregular, and the average product shows little uniformity. There are, however, great differences between the many different types of robusta. Some of them have comparatively large beans, larger even than arabica; others again have very small ones. As regards the quality, though being inferior to Java-arabica, the taste is generally considered to be good and superior to the ordinary arabica sorts, as Santos.

Doctor Wildeman states:

It is objected that the berries of the robusta group and of other African coffees are small in size and inferior in flavour; but the continually increasing quantities of these coffees sold in Holland, and the satisfactory prices they fetch show that the public is beginning to appreciate them. No objections will be made to the size of the berries when by means of careful cultivation and especially of right preparation, a coffee is obtained equal in flavour to the (old) Java and Arabian coffee.—Philippine Agricultural Review.

CASSAVA POISONING.

The Agricultural News (West Indies) contains a useful article on this subject in its January issue.

Though Sweet Cassava (eaten boiled) is not so poisonous as the bitter variety (usually prepared into flour), neither should be eaten without careful and thorough cooking, so that the roots will be cooked throughout and not only superficially with a hard inside. Before cooking however, the rind should be removed and the root cleansed by scraping, as the poison is found most in the external layers of the roots. It is advisable also to eat cassava only when freshly cooked, as cooked cassava that has been allowed to stand for some time has been found to be unwholesome.

In case of poison lose no time in seeking the aid of a medical man who can administer the necessary hypodermic injection. In the meantime adopt the following measures:—

1. Place the patient in the open air or near an open door or window.
2. Empty the contents of the stomach by inducing vomiting either by tickling the throat or administering a tumblerful of mustard and hot water (a table spoon of mustard to a half pint of water for an adult, a teaspoon to half a tumbler for a child).
3. If the patient shows signs of becoming lifeless, remove the clothes from the body and pour cold water from a height on to the back of the head, spine and chest: afterwards dry and put on warm clothes.
4. Rub the arms and legs briskly to keep up circulation and if cold apply hot water bottles.
5. Apply smelling salts to the nostrils off and on.
6. As soon as the stomach is empty give a strong dose of rum, whisky or brandy diluted with twice the quantity of water.
7. If breathing is arrested carry out artificial respiration.

FIBRES.

SISAL HEMP.

A record of the progress of the sisal hemp industry in the East Africa Protectorate is given in the Ann. Rep. Dept. Agric., Brit. East Africa, 1912-13. The returns from the plantations have been so satisfactory that a considerable extension of the industry is anticipated. At the end of 1912, the total area under cultivation was about 7,000 acres, distributed as follows: Punda Milia, 1,000 acres; Makuyu, 750 acres; Voi, 1,000 acres; Nyali, 1,000 acres; Powysland, 1,160 acres; Gazi, 1,000 acres; Maseno, 600 acres: other areas, about 490 acres. Several improvements have been made in the decorticating machinery, and simplified methods of brushing and drying the fibre are being adopted which will effect an economy in labour. Sisal plants grown at the coast yield a higher percentage of fibre than those grown in the highlands and also furnish a finer fibre, but in the highlands a larger yield per acre is obtained and the cost of labour is less. The following data were obtained as the result of certain tests carried out at Punda Milia. From 912 leaves, weighing 2,263 lb. or an average of 2·48 lb. per leaf, a yield of 52½ lb. (2·32 per cent.) of dry, brushed fibre was obtained, or about 1 lb. of fibre from 17 leaves. The plants from which these leaves were cut were spaced 8 ft. × 8 ft., this arrangement giving 681 plants per acre. Taking 160 as the average number of leaves produced per plant during its life, the total yield per acre, when calculated by the above figures, is 6·240 lb., or a little less than 3 tons. Considerable attention is being devoted to the question as to the best treatment of the land after the full crop has been gathered in order to render it fit for further planting. It is suggested that the stumps would dry more quickly if small quantities of arsenite of soda were injected into them. They could then be collected and burned and the land ploughed again before weeds had become established to any great extent. Experiments are being conducted on these lines at Punda Milia.

An interesting account of the present position of the various sisal hemp estates in the Protectorate is given by the Chief of the Economic Plant Division. The experience gained by Messrs. Swift and Rutherford at Punda Milia has led to the following conclusions: The establishment of a plantation of 1,000 acres requires a capital of £4,000. The cost of machinery required to prepare the fibre from leaves produced on 1,000 acres is £5,000. A return cannot be expected until at least four years after the plantation has been established. One ton of dry fibre per acre per annum may be anticipated for three years from the date of the first cutting. The cost of producing a ton of dry fibre is about £12, including £1 per ton for transport to the railway.—Bulletin of the Imperial Institute.

NEW ZEALAND FLAX.

An account of New Zealand hemp (*Phormium tenax*) industry in St. Helena during 1913 is given in Colonial Reports Annual, No. 799, St. Helena Report for 1913 (Cd. 7050 40). The quantity of leaves treated at

the Government mill amounted to 1,296 tons, and yielded 128 tons of fibre and 39 tons of tow. The fibre realised an average price of £28 10*s.* per ton, and the tow £14 10*s.* per ton. The year's working resulted in a net profit of £137, and the results are regarded as very satisfactory. A new mill was opened by a private firm in 1913, July and by the end of the year had dealt with 589 tons of leaves, with the production of 38 tons of fibres and 14½ tons of tow. The amount of phormium now under cultivation is considered sufficient to ensure a continuous supply of leaves to both mills. Further planting is being carried out every year, and ere long there should be enough material available to justify the erection of a third mill.—Imperial Institute Bulletin.

MANURING COTTON.

C. B. WILLIAMS.

The effect of different carriers of phosphoric acid on the maturity of the cotton crop is noted as follows: With acid phosphate added to an application consisting of manure salt and dried blood, there was almost 13 per cent. increase in seed cotton open of total crop at the first picking and more than 7 per cent. increase at the end of the second picking. This application also gave 22 per cent. more open at the first picking and 12 per cent. at the end of the second picking than was secured from the no-fertilizer plat. Basic slag was found to hasten maturity even more than acid phosphate, as practically one half of the cotton was open at the first picking on the plat which received this material in connection with manure salt and dried blood. This was about 12·5 per cent. more than with acid phosphate. When this latter material was applied in the drill in connection with a ton of stable manure per acre, the effects upon hastening maturity were markedly reduced. Where high-grade finely-ground phosphate rock was used at the rate of 274 lb. per acre in connection with a ton of stable manure, and both were applied in the drill, the percentage of total seed cotton opened at the first picking was about 35, and at the end of the second more than 23 per cent. greater than on an adjacent unfertilized plat.

As to the effect of different carriers of nitrogen, when 78 lb. of high-grade blood was added to acid phosphate and manure salt the percentage of total crop open at the first picking was increased 3·3 per cent. Where one-half the blood was replaced by an equivalent of nitrate of soda, used as a side dressing and applied early in July, the percentage of total crop open at the first picking was generally greater. When one-fifth of the nitrogen was derived from nitrate of soda and the remaining four-fifths from dried blood there was a rather marked increase in the percentage of total crop open at the first picking. When the nitrogen was derived from blood, one half of which was applied at planting and the remainder as a side dressing early in July, a larger percentage of total crop opened at the first picking than where nitrate of soda was divided and applied in the same way. With cotton seed applied in the drill at planting, the effect upon maturity was about the same with dried blood; while with stable manure there was a material increase in the percentage of total crop open at the first picking, but no difference at the second picking.

In regard to potash it is noted that as its proportion increased the percentage of total crop opened at the first picking gradually diminished, except for the year 1907, August of which had about 3 in. less rainfall than was normal.

For the types of soil studied, increasing from 200 to 800 or 1,200 lb., the amount of the application per acre of a fertilizer analysing 7 per cent. available phosphoric acid, $2\frac{1}{2}$ per cent. nitrogen, and $2\frac{1}{2}$ per cent. potash was accompanied generally by an increased percentage of the seed cotton open at the first picking.

The following tentative deductions are made relative to the influence of fertilizer upon the growth of cotton: "(1) Fertilization with ordinary applications of commercial fertilizers hastens maturity. (2) Sandy and sandy loam soils whether fertilized or unfertilized, yield larger percentages of total cotton open at the first 2 pickings combined than do red clay soils. (3) Heavy phosphoric acid ($N\text{-}P_3\text{-}K$) fertilization on sandy and sandy loam soils, and medium heavy ($N\text{-}P_2\text{-}K$) applications of phosphoric acid from basic slag, have produced the largest percentage of total seed cotton open at the first picking. (4) Normal (N-P-K) fertilization yields on both sandy and red clay soils a larger percentage open at the first picking than high nitrogen ($N_3\text{-}P\text{-}K$) applications. (5) High nitrogen ($N_3\text{-}P\text{-}K$) applications generally yield on all types of soil studied larger percentages of total yield open at the first picking than high potash ($N\text{-}P\text{-}K_3$) applications. (6) Air slaked lime alone does not hasten maturity, but when used in connection with commercial fertilizers it augments their influence in hastening maturity."—Experiment Station Record

PRODUCTION OF JUTE AND HEMP.

The following table shows the world's principal exporting countries, the cultivated plant which yields the fibre in each case, and, where figures are available, the exports in tons of fibre:—

Fibre	Botanical name of plant	Exports, 1912 Tons
Indian Jute	*Conchorus* spp.	2,000,000
Russian hemp	*Cannabis sativa*	50,140
Italian hemp	,,	44,600
Hungarian hemp	,,	
New Zealand hemp	*Phormium tenax*	
Manila hemp	*Musa textilis*	172,000
East Indian hemp	*Crotalaria juncea*	
Mauritius hemp	*Furcraea gigantea*	
Java hemp	*Agave cantala*	10,000
Sisal hemp—	*Agave rigida*, var.	
Mexican, etc.	*elongata*	849,698
German East African	,,	16,000
British East African	,,	
Bahamas, Florida	*Agave sisalana*	

It will be seen that a large number of different species of plants are employed in many different countries of varied climates. Each species is frequently represented by several varieties or strains. As well as the countries above-mentioned, it should be pointed out that several other places are beginning to establish a hemp industry, or at least attempting to; for example, Fiji, Jamaica, and Sicily. In this latter country a strain of *Agave sisalana* has been acclimatized.—Agricultural News.

POULTRY.

EGG-LAYING COMPETITION IN ENGLAND.

The following is a comparative summary of the results obtained in the two sections (at Sedlescombe):—

	Small flock Section.	Large flock Section.
Total number of eggs laid	23,317	21,302
Average per bird	188	171·8
Highest score per pen of 4 birds	951	898
Average per bird in best pen	237·7	224·5
Highest individual bird record	277	253
Percentage of 1st grade eggs	87·5	85·2

	Small flock Section	Large flock Section.
	£. s. d.	£. s. d.
Total realised by sale of eggs	140 2 6	127 13 10
Average price per dozen	1 5¼	1 5¼
Total profit over cost of feeding	87 14 1	75 5 5
Average value of eggs laid per bird... ...	1 2 7	1 0 7
Average cost of feeding per bird	8 5·4	8 5·4
Average profit per bird	14 1·6	12 1·6

These figures show that very satisfactory results were obtained in both sections, those in the small flock section being especially good, and new records were set up for pen score—951, an average of 237·7 per bird, and also in the general flock average—188 eggs per bird.

The feeding cost of 8*s.* 5·4*d.* per bird is undoubtedly high, but this must be so when production is heavy. It was, to some extent, increased in this instance by the war prices paid during the last nine or ten weeks of the test. It should also be pointed out that all foods were the very best of their respective kinds, bought in comparatively small quantities relative to the size of the flock and in order to ensure freshness.

On the other hand, the return per bird over and above the cost of feeding, which after all is the important point, were exceptionally high, being 14*s.* 1·6*d.* in the small flocks, and 12*s.* 1·6*d.* in the large. The comparatively high average price (1*s.* 5·4*d.* per dozen) received for the eggs was due primarily to the guarantee of freshness and, in part, to the high prices ruling throughout the last few weeks (2*s.* and 2*s.* 3*d.* per dozen) on account of war conditions.

The following table gives the egg production of the various breeds competing, and their averages* :—

SMALL FLOCK SECTION.

No. of pens.	No. of birds.	Breeds.	Total eggs laid.	Average per pen.	Average per bird.
11	44	White Leghorns	8,892	808·3	202
1	4	Black Leghorns	691	691	172·7
11	44	White Wyandottes	8,058	732·5	183
2	8	Buff Orpingtons	1,339	669·5	167·2
2	8	White Orpingtons	1,312	656	164
2	8	Buff Rocks	1,510	755	188·7
1	4	Rhode Island Reds	778	778	194·5
1	4	Red Sussex	621	621	155·2
12	48	All Light Breeds	9,583	798·5	199·6
19	76	All Heavy Breeds	13,618	716·8	179·2

LARGE FLOCK SECTION.

No. of pens.	No. of birds.	Breeds.	Total eggs laid.	Average per pen.	Average per bird.
11	44	White Leghorns	8,039	730·8	182·5
1	4	Black Leghorns	736	736	184
11	44	White Wyandottes	7,547	686	171·5
2	8	Buff Orpingtons	1,252	626	156·5
2	8	White Orpingtons	1,319	659·5	164·8
2	8	Buff Rocks	1,184	592	148
1	4	Rhode Island Reds	634	634	158·5
1	4	Red Sussex	408	408	102
12	48	All Light Breeds	8,775	731·2	182·8
19	76	All Heavy Breeds	12,344	649·7	162·4

Large and Small Flocks.—The results generally show a decided advantage in favour of small flocks.

* In the small flock section, 202 eggs per bird is a remarkably fine average. It is also a significant fact, as pointing to the accuracy of the test, that the difference in the two sections in the averages per bird of the Light and Heavy Breeds taken separately is precisely the same as between the total flocks, viz., seventeen eggs per bird.

Without assigning any special or general reason for this, there appear to be several contributory causes more or less affecting the result, some of which may or may not be encountered.

The chief of these, and the most difficult to contend against, is the difficulty of controlling infectious diseases in the case of large flocks. This was experienced in the Sedlescombe test, and doubtless accounts to a considerable extent for the disparity in the egg yield.

Roup was imported at the outset, and although both sections were affected the trouble in the small flocks was easily controlled and effectually stamped out within a very short time. In the large flock section it spread rapidly and a large proportion of the birds became affected. It was quite two months before it finally disappeared.

Then the matter of feeding has its influence. When dealing with small numbers it is possible to study to a great extent the varying conditions and requirements of the individual birds, and to regulate the feeding accordingly, but with large flocks all must necessarily be treated alike.

Seventeen deaths (6·8 per cent.) occurred during the test—eight in the small flocks and nine in the large. Of these eleven were due to troubles of the reproductive organs.

In comparing the general health and condition of the birds it was impossible to overlook the fact that those in the small flocks were more alert and brighter in face and comb, whilst there was too great a tendency on the part of the birds in the large house to remain inside even on days most favourable to foraging in the open.

Those in the small flock, on the other hand, were usually to be found outside even in the roughest weather, without any adverse effect upon production.

At no period of the test, with the exception of the first three days, did production in the large flock exceed that of the small. The latter showed distinct superiority even in bad weather, when it might reasonably be expected that the extra comfort of a large roomy house would have given an advantage to its occupants.

In a similar test carried out concurrently at Burnley by the Northern Utility Poultry Society these results were, in the main, confirmed, though the disparity in production was considerably less, but that may fairly be attributed to the absence of any outbreak of infectious disease.

From the economic standpoint large flocks have some advantage both in regard to the original outlay on plant and also in the subsequent labour charges, but the saving effected would certainly not be sufficient to compensate for such a disparity in egg production as that shown in the test, a difference of 2*s*. per bird.

The result of the test may, therefore, be regarded as justifying the conclusion that laying hens, like other kinds of live stock, give better results if kept in small flocks than when large numbers are dealt with.—Journal of the Board of Agriculture.

APICULTURE

BEE SWARMS IN CEYLON.

A. P. GOONATILLAKE.

The swarming seasons in Ceylon are usually February-March and July-August, but these may differ according to weather and climate. Swarming usually occurs just before the honey flows and when the colonies of bees are excessively strong. Nature has implanted in the bee an instinct to swarm in order to propagate their species, and when a colony is overflowing with bees they divide themselves into two sections. The first to leave the hive is the *prime swarm*. Before swarming the bees begin building queen cells, and when these are ready for occupation the queen lays her eggs in them. As soon as these cells are sealed (with ripe larvæ in them) the prime swarm leaves the hive with the original mother queen in quest of a new home, leaving a part of the bees with the embryo queens. When these queens are hatched out one or more swarms issue from the remaining bees each with a virgin queen. These are called *cast swarms* or *after swarms*. Cast swarms usually issue a week or so after the prime swarm, the new queens being hatched about a week from the day the queen cells are sealed. More than one cast swarm may issue in a day according to the rate of hatching out of the queens. When all the cast swarms have issued the bees left in the hive adopt the latest born queen, which proceeds to destroy the remaining queen cells (if there are any), killing the embryo found within. According to the "A. B. C. of Beeculture" when there are enough bees in the hive to form only a single cast swarm all the virgin queens that have hatched out accompany it. Bees sometimes swarm outside the regular swarms. This is called late swarming, and is more or less due to want of room in the hive. Sometimes swarming is done without any apparent reason. When the honey flow is on and the combs in the hive are full of brood pollen the honey bees lose no time in starting queen cells and forming the late swarms in order to find more room for their stores. If the beekeeper is observant he can prevent swarming by providing a super (upper storey) or two as the occasion demands, and thereby secure a large quantity of surplus honey.

It is of course to the benefit of the beekeeper to prevent swarming. The safest and surest way is to cut out all the queen cells in the hive before they are sealed or to remove the old queen with a sufficient number of bees into a new hive leaving only one queen cell with the remaining bees in the old hive.

Pure bees-wax is of commercial value. The secretion of wax cannot be seen by the naked eye, but with a magnifying glass one could detect tiny scales of wax protruding from between the rings in the abdomen of the bee Bees generally secrete wax when they are quite full and the heat is excessive. It is said that to produce one pound of comb, bees consume about 20 lb. of honey.

"Bee bread" is the term used for pollen stored in the combs. It is used to prepare chyle food for the larvæ. Pollen gathered by the bees is carried into the hive on their thighs.

Chyle food is a milky substance composed of honey and pollen with which young larvæ are fed, and can often be seen at the bottom of worker cells with very young larvæ floating on it.

MYCOLOGY.

FUNGUS DISEASES OF PLANTS.

C. O. FARQUHARSON.

Everyone is more or less familiar with fungi in the shape of edible mushrooms, or the large bracket shaped forms that grow on decaying timber everywhere, down to the very inconspicuous moulds and mildews that grow on all sorts of damp material such as old cocoa pods, cornstalks and heads, etc. The vast majority are to all intents and purposes harmless but several, with which people in general are not so familiar, are the causes of the serious diseases of plants. Those fungi which live on decaying matter are called *saprophytens*, others which attack and kill living plants, *parasites*. Some, however, are at one time parasites, but in the absence of a living host plant, continue their existence on decaying matter. It is from this class in particular that the farmer has most to fear. Some of these fungi live on the soil and attack the roots of plants, others attack the stems, or branches, leaves or fruits. Every planter is familiar with brown-rot of cocoa pods, where the fungus causes the pod to rot before it has time to mature. Sometimes stored yams rot without any apparent reason, but here also some fungus is the blame. The fermentation of cocoa, it may be mentioned, is largely the work of fungi, more particularly of minute yeasts. And yeast of the bakers is also a fungus.

Just as the higher plants like maize, cassava, cocoa, or rubber reproduce themselves by seeds, so the fungi reproduce themselves by spores, which are blown from one plant to another and so spread the trouble.

Fungus spores are so small that single ones cannot be seen with the naked eye, but they are produced in such great numbers as to appear like dust. An example of such spore "dust" may be easily seen by keeping a diseased cocoa pod, for example, in a closed vessel or tin box with a lid on it to prevent the pod drying. In a day or two it will be covered with a black powder which rubs off on to the hand.

Spores of different fungi have different colours. There is a very large fungus (Olu-igi) which grows on dead oil palm. Often a log on which this fungus is growing will be seen to be covered with brown dust, *the spores:* after bush has been burned in the dry season, pieces of wood, grasses and such like, which are not completely burned but only scorched, nearly always become covered with pink "dust" which is composed of spores of a fungus that lives on burnt wood. These spores germinate where moisture is present, forming what is called the mycelium. It is this mycelium which enters plants and causes their death.

Mycelium is generally invisible, inside the host plant, but in some diseases it is quite visible. On a diseased cocoa pod kept in a closed tin box or glass vessel the first thing to appear may be pale green or whitish tufts like wool, only the threads of which the tufts are composed are very much finer. The single threads are called hyphæ and all together compose the mycelium. The spores are to the mycelium what seeds are to a tree, that is, they are the

means of reproduction, but it must of course be understood that "spores" are not "seeds." A plant is often produced by "cuttings" but "cuttings" are not "seeds," though they also are a means of reproduction.

Many spores will only germinate on a particular kind of plant. If a large number of similar plants are grown together as is the case in plantations, some of the spores are sure to light on the proper plant. In the case of a bush tree that is attacked, it is surrounded generally by a number of plants entirely different and unrelated.

A fungus which attacks one may not be able to attack any of the others. Hence we do not find large numbers of bush plants suffering from disease, and the death of one here and there is scarcely noticed. But in a plantation if one cocoa tree is attacked its neighbours must be protected from it, or they in turn may be attacked.

This is where man comes in, as the friend or enemy of plants. If he does rightly he will take measures immediately to prevent further spread by destroying the diseased parts of any attacked trees, and all the plants so attacked, if necessary. Here is where judicious pruning off of attacked parts and their destruction by burning or burying is very useful. If a plant is attacked at the root special treatment will be required, which will be described in detail later. By neglecting to take these precautions, or by carrying them out carelessly, man becomes an enemy of his own plantation. If man is not to be ranked among the enemies of agriculture he must, by careful farming and attention to sanitation, lessen the effect of any conditions unfavourable to his crops and favourable to their diseases.

GENERAL LINES OF TREATMENT OF FUNGUS DISEASE.

The most essential thing to remember is that prevention is better than cure, and in general a good deal easier.

Methods of prevention are :—

(1) Clean cultivation to prevent the growth of saprophytic fungi on decaying plants, prunings, etc., lying about in plantations. All such rubbish should be burned or buried, the former method being the safer. The initial expense of cleaning a plantation in which a permanent crop is growing may be fairly high, but subsequently sanitary work can be carried out at a very little cost.

The most serious root diseases of Para rubber and cocoa generally originate in decaying bush stumps, and the unstumped plantation is open to far greater risk from such diseases than one that has been stumped.

(2) Excessive moisture in the air, due to close planting or over shading, is extremely favourable to the spread of disease like cocoa pod rot. Planting distance should be selected so as to prevent this.

Once pods are attacked they should be collected and destroyed, by burying or burning. Once a pod is attacked there is no cure. A fungus is a plant, and once well inside a pod it cannot be killed by means of poisonous sprays (see below) without killing the pod.

Sprays are effective only in preventing the spread of spores.

(3) Excessive moisture in the soil favours root disease, and drainage of low lying land which tends to become swampy should be strictly carried out.

SPECIAL LINES OF TREATMENT OF FUNGUS DISEASES.

Sprays.—Reference has been made to the treatment of fungus disease by chemicals in the form of sprays.

A considerable variety of these is in use but their profitable employment depends largely on the careful carrying out of the estate situation. If a plantation is littered with decaying wood and bush stumps, is over shaded, if pruning is not carried out at all, or only by a reckless use of matchets, or if the trees weakened by the want of shade, or were in any way subjected to bad cultural methods, spraying will do little or no good, and is not to be recommended.

Their use is largely preventive. They are employed to kill spores and in this way to prevent the spread of fungus disease.

Pruning.—As already pointed out, a fungus once it is inside a plant cannot be treated by any spray. The attacked part must be cut off, care being taken that no diseased part is left. Diseased wood is generally discoloured or dry.

In pruning off a diseased part the cut end of the branch or surface of the stem should show nothing but healthy wood. All cut surfaces or wounds should be coated with coal tar to prevent fresh attack.

Wherever a tree is wounded and the wound left untarred, disease is sure to occur. Only the slightest injuries that the tree can heal quickly can be neglected.

Proper pruning tools should be used, and for this purpose the use of the matchet should be absolutely forbidden.—Bulletin of the Agric. Dept. of the S. Provinces of Nigeria.

A SUGGESTION FROM "TROPICAL LIFE."

We understand that an appeal has been made for £3,000 with which to endow three Tropical Agricultural Scholarships of £40 a year, tenable for three years, at Aberdeen University, in memory of the late Mr. Joseph Fraser, known to many as "Fraser of Ceylon." We do not wish to deprive Aberdeen of such a welcome present, but it does seem to us a mistake not to concentrate all such efforts towards the improvement of our knowledge and training in tropical agriculture on the college scheme by voting the money towards the establishment of an Agricultural College in Ceylon What better monument could be raised to Mr. Fraser than a tablet in the College when it rears its dome proudly towards heaven, telling the passer-by or student," I was called into being with £3,000 subscribed to the memory of "Fraser of Ceylon."? If Aberdeen likes, let her have the money until it is wanted for the College, especially as three, if not six, students are likely to be able to utilize it if this were done, since the war will, we fear, put back the establishment of the College for a little time yet.—Tropical Life.

ENTOMOLOGY.

INSECT PESTS OF NIGERIA.

W. A. LAMBORN

All the various pests are to be found here and there in the bush, but only in small numbers because conditions are unfavourable for their undue increase.

A moth or beetle which in the bush must fly far and wide in search of a food-plant or the plant on which its grubs feed is in greater danger of attack from its enemies, and these are numerous.

Birds, lizards, frogs and many other animals in Nigeria .pay a most important part in keeping insects down, but other insects are the most active of all agents in preventing too serious an increase.

Some of these insects, for instance the robber fly and the praying mantis, prey directly on other insects and will devour the more brightly coloured and conspicuous insects such as many beetles and bugs which are possessed of nauseous qualities rendering them distasteful to other animals.

Other insects such as various wasps collect, and store up as food for their offspring, insects injurious to plant such as various grubs and thus many do a vast amount of good. A particular wasp for instance in Nigeria stores up a green caterpillar which feeds on the leaf of cotton. Various flies and certain wasplike insects check the increase of other insects by laying eggs in their grubs.

These natural checks suffice as a rule to limit the number of insects under natural circumstances, but as the farmer cuts down bush and begins to cultivate in its place plants often nearly related to bush plant, the insects harder pressed for food turn their attention to the crops, and finding unlimited food of excellent quality increase and multiply to such an extent that their natural enemies are unable to cope with them; such insects by damaging crops must accordingly be looked upon in the light of pests.

Now it must be apparent to all that the country as a whole, and each individual farmer in it, sustains grievous loss year by year owing to these pests; but as yet little attempt has been made to check their attack.

As an example of damage caused by pests one may take the case of stored grain. It has been found in the laboratory at Moor Plantation that small test samples lost no less than one-fourth of their weight in two months from combined attack by the little black weevil and a little brown beetle. Again, farmers who cultivate cotton will be familiar with the red and brown cotton stainers which suck the vitality out of the young unripe bolls, ruining both lint and seeds, and with the grub which eats away the whole contents of the bolls.

Those who have plantations of cocoa, coffee and the various other products of the country will also be able to call to mind other insects which are to be looked on as pests; since they may eat away leaves, or bore into the very heart of a plant, and are even known to kill plants by gnawing away the roots.

As an instance of the latter damage one may mention that only last year the grubs of a certain beetle were found to have eaten up in the ground whole plantations of yams; and though this particular pest was fortunately not widespread, it must be borne in mind that such may not always be the case.

It occasionally happens that for reasons which as yet one understands imperfectly, such pests increase on an alarming scale, and the extensive damage must then spell hardship and monetary loss to the farmer and his family, and it is therefore necessary to try and cope with these pests.

MEASURES FOR INSECT CONTROL.

These may be employed both to prevent and to remedy insect attack.

With a view to preventing insect attack farmers can, for instance, remove dead and otherwise useless plants. Old cotton plants left in the ground are used by the insects which especially attack cotton as food and as breeding places until a fresh crop is ready for them. Maize husks and stalks certainly lead in this way to the increase and spread of the insects of which so large a number attacking maize exist in this country.

The attack of weevils on maize can largely be prevented by harvesting immediately the grain is ripe.

Some insects lie buried in the soil during the interval between crops, so that careful tilling of the ground can do much to disturb them and expose them to the attack of enemies.

To remedy insect attack hand picking can be employed where the insects feed by day and are large and numerous

The cotton stainer in especial is best dealt with in this way, and it is possible to make the collecting of these insects by hand a simple matter by growing near the cotton plots other plants, such as the okra, which the stainers prefer to cotton, and by putting down as traps in the furrows handfuls of lint which is useless for other purposes.—Bulletin No. 1. Agricultural Dept. of the Southern Provinces of Nigeria.

CATCHING AND DESTROYING INSECT PESTS.

T. BAINBRIGGE FLETCHER.

Under the heading of Mechanical Methods may be grouped those means of control which are intended to reduce the numbers of pests, either before or after they have attained destructive proportions, without making use of insecticidal liquids, powders or gases, but it is difficult to draw any definite line between mechanical and insecticidal methods. Amongst mechanical means may be included hand-picking, collection by hand-nets, or bag-nets, hopperdozers, light traps, attraction to baits and traps, trenching, burning, banding of trees, screening, destruction of borers in trees, removal of dead trees and branches of trees, and cutting out of dead hearts.

The collection of insect-pests by hand is an extremely simple method which has also the merit of remarkable efficacy if carried out regularly and on the first appearance of a pest while its numbers are still small. If pests are

allowed to increase, their numbers soon become so great that hand-picking is out of the question; but in the early stages of an attack a vigorous onslaught will often nip the outbreak in the bud. For example, in 1912 we had a small outbreak of *Kumblipuchi* on the Central Farm at Coimbatore : one *chokra* was set to collect the caterpillars and in four days had collected several hundreds with the result that little damage was done by that brood and no subsequent broods were even noticed; if the first brood had not been checked, at least two subsequent broods would have followed and considerable damage would have been done, as actually happened in the surrounding districts under similar conditions except that no action was taken. A measure of this sort is so simple and inexpensive as to be within the reach of all, and every cultivator should make a practice of killing every crop pest on sight wherever met with and more especially when found on his crop in small numbers, for it is the prevention of an increase that should be aimed at. It is of little use to start killing the *puchis* after they have attained such numbers that the crop is already spoilt.

The method of hand-picking must be adapted to the particular insect concerned, the insects being simply caught and squashed in the hand (smooth caterpillars, large bugs, many beetles) or crushed under foot (large caterpillars) or dropped into a pan or vessel containing water with a film of oil on the top (*Kumblihulas*, blister beetles). Or the insects may be shaken on to a sheet or cloth or into a vessel of oil and water. For the collection of cotton bugs use is sometimes made of a tin funnel fitted into a bag in which the bugs fall and are unable to escape. For collecting insects from moderately tall plants an ordinary umbrella, held upside down, makes an excellent tray if nothing else be available.

A small hand-net is particularly useful for catching the more active insects which are difficult to capture with the unassisted hand. It is simply and cheaply made of a bag of light cloth secured around its mouth to a hoop of cane or bent wood which in its turn is fastened to the two arms of a Y-shaped branch of which the main stem forms the handle of the net. With the help of a net of this kind a cultivator may easily rid his fields of flying pests such as rice-bug, blister beetles and rose-chafers, while it may also be used for grasshoppers. The insects caught in the net, by sweeping it over the crop, may be killed simply by crushing them by hand or under foot or with a flat stone, or the contents of the net may be emptied into a vessel containing water with a little oil on top.

For grasshoppers a bag-net is used, as this enables the whole surface of an affected area to be worked over and practically all the grasshoppers to be swept up in the bag. The bag-net is simply a large bag of cloth about four feet wide and two feet across at the mouth and five or six feet deep and tapering to a point behind. The mouth of the bag is fitted at the sides with two short bamboo poles each four feet or five feet long, to keep the mouth open and to form handles to hold the net with, and a piece of bamboo is also fastened into the lower edge of the mouth to keep it straight and so prevent it from sagging up off the ground. The end of the net is weighted with a piece of stone, brick or wood to prevent it ballooning up and spilling the catch out of the mouth when in use. The bag-net is worked by the two men

who each grasp one of the bamboo handles and sweep it over the crop as quickly as possible. The hoppers, being disturbed by the passage of the net, jump off the plants and are swept into the net by the lower edge of the bag before they have time to reach the ground. The grasshoppers, at the end of each run, are shaken down into the bottom of the bag and killed by crushing or by emptying them into a vessel of oil and water. For obtaining as large a catch as possible the following precautions should be observed :—(1) the net must be swept as closely along the ground as possible, (2) the men working it must run at a quick pace and (3) as far as possible the bag should be swept against the wind.

A single bag-net will work over nearly three acres of ground daily and will require the services of three men, two working it and the third relieving the others by turns. Where a field is badly infested by grasshoppers it will require to be gone over several times, the number of baggings required depending on the degree of infestation, and the natures of the soils and crops. It is of course impossible to bag cereal crops when they are grown up, as it is impossible to get the net sufficiently near the ground to catch the hoppers and because the damage done by the workers running through the field would be too great, but such crops may easily be bagged without damage before they have attained a growth of three feet.

The efficiency of both the hand and bag-nets may be increased by soaking them with oil before use, but this practice is not economically sound unless waste oil is available at a nominal cost.

Light tarps are used to attract and kill the adults of various crop-pests, especially those which are stem-borers in their early life and therefore difficult to check in their directively destructive stages, They are simple in construction and inexpensive to work and it is probable that light traps may be found to be the best means of checking such pests as the stem-borers of paddy (*Schœhobius bipunctifer*) and of ragi (*Saluria inficita*). An ordinary lamp holding sufficient oil to burn all night, may be used and is placed among the crops, either standing in or suspended just above a pan of oil and water which should project at least six inches on each side of the lamp. The lamp, should be so placed that the flame is situated just above the tops of the growing crop and that the light is visible all round. A mixture of kerosene and coconut oil gives a good light at small cost. The lamp should be lighted at dusk and left burning all night. The insects, which are attracted by the light, dash against the glass of the lamp-frame and fall into the tray of oil and water below this and are suffocated by the oil. Very large numbers of insects are sometimes caught in this way, especially on still, warm, dark, moonless nights. It is usually not worth while to put out a lamp-trap on bright moonlight or windy nights.

Baits and traps for the attraction and capture of crop-pests are so numerous and various that no complete account can be attempted here. Many nocturnal caterpillars, crickets and other insects which hide away in the day time are often difficult to track down and deal with, but they may sometimes be trapped by laying down fresh sods of turf, planks, etc., in likely places and these may, if required, be baited towards the evening with tender shoots (e.g. lucerne) and examined next morning for the presence of insects.

The trenching of gelds and smaller areas, such as seed beds, is a simple and efficient method for assisting in the exclusion of creeping insects, such as caterpillars, which may otherwise invade crops. A small furrow of even a few inches breadth and depth will often check the inroads of such insects if the inside edge of the trench is vertical and composed of fairly loose soil. A few small steep-sided pits dug at short intervals along the bottom of such a trench will serve as further traps, as the insects will generally wander some distance along the bottom of the trench and are therefore likely to tumble into the pits. In the case of *Kumblihulas*, if sufficiently wide and deep trenches are available, a few fresh branches may be strewn in them to provide a certain amount of flood and shelter and these may be examined and renewed daily and all the caterpillars found in hiding killed; but care must be taken that such branches do not provide a bridge up the sides of the trench. In cases where a ditch of standing water forms the boundary of a field, a little oil spread over the surface of the water will form a barrier against invasion by caterpillar pests.

Burning is sometimes a practical method of dealing with crop-pests, especially in the case of many of the hairy caterpillars which gather gregariously and often form large patches on tree-trunks. A bundle of straw soaked in oil and fastened to the end of a bamboo makes an efficient torch for such purposes. The burning of stubble has already been dealt with.

Fires may also be used sometimes in the control of crop-pests which are attracted and killed by the flames at night, and insects may also in some cases be driven out of crops at critical times by the judicious use of smoke. Mango hoppers, for example, may sometimes be driven temporarily out of the trees by kindling smoky fires beneath the branches at the blossoming period when the flowers would otherwise be spoilt by the "honey-dew" exuded by the hoppers.

In the case of trees the access of pests may often be prevented by banding the trunk with a sticky or oily mixture either painted directly on to the trees or applied on a band of cloth or paper fastened around the tree. A mixture of tar and crude oil emulsion, in equal parts, may be recommended as efficacious and harmless to trees; but no mixture of this sort can be expected to last more than a short time in India. Wide bands of tin may be nailed on to the stems of coconut palms to prevent the access of rats.

The screening of choice fruits and vegetables to guard them against the attack of fruit-flies and other pests is a simple and obvious method of protection.

Many trees are subject to the attack of large boring caterpillars, the larvæ of beetle and moths, which pierce galleries through the living wood and in bad cases may even kill the tree or bush so attacked. A simple remedy is to cut out the larvæ with a knife and to paint the wound over with tar to prevent access of other insects or of the spores of fungi or bacteria. The use of the knife in such cases, though apparently drastic, is usually quite successful. Mango trees especially are subject to attack by a common tree-boring beetle larvæ (*Batocerarubus*) and orange trees also are often affected by the grub of another species. Sometimes the grub can be killed or pulled out with a piece of wire, but usually it is better to cut down to

it and clean out the gallery which is otherwise likely to give access to other diseases later on. A piece of wire with a barbed point is used for destroying palm beetles (*Oryctes rhinoceros*) in their burrows in tender shoots of palms, the beetles being transfixed on the barb and withdrawn and the burrow tarred over.

A tree or portion of a tree which is dying or dead at once becomes a suitable breeding-place for innumerable insects, mostly beetles, which feed upon dead or decaying wood and some of these may be a source of danger to living trees and branches and should therefore be removed and used for fuel or other purposes and not be left standing or lying about the fields. This is especially the case with rotting stumps of palms and aloes which are usually found to be swarming with the fat white grubs of *Oryctes* which will presently emerge as beetles to attack the palms in the vicinity.

Cereals, such as sugarcane, cholam and paddy, generally exhibit signs of attack by stem-borers by a withering of the central shoot which is frequently completely detached so that it comes away from the plant at the least pull. Such a withered central shoot is called a "deadheart," and its presence almost invariably shows that a caterpillar is boring inside the stem of the plant. A watch should be kept for the first appearance of such deadhearts especially in a valuable crop such as sugarcane, and they should be rigorously cut out and the caterpillar killed to prevent the attack from spreading. Shoots so attacked are in any case quite useless; whereas, if they are cut back as soon as noticed, new shoots will generally be thrown up and little loss result. But the importance of prompt cutting out of deadhearts lies in the prevention of further damage by later broods of the insects concerned.—Indian Agriculturist.

COIR YARN MAKING IN VILLAGES.

Along the South-west coast, between Colombo and Galle, it is the commonest sight to see the women and older members of village households preparing coir-yarn from coconut husks. The husks are first soaked in water and the fibre, which is beaten out with sticks, twisted by hand into yarn, From 25 cents worth of husks (100) it is possible to make 50 cents worth of yarn, and a good worker should be able to produce 16 skeins of 16 yards each (worth $1\frac{1}{2}$ to 2 cents per skein) a day.

DIVI-DIVI.

The Board of Trade Journal (December 24) refers to Divi-divi pods (*Cæsalpinia coriaria*) as the source of a useful dye. The tree which is well-known in Ceylon was once boomed as a valuable tan-producing plant and many were induced to plant it. Now it is only found in hedges or grown for ornamental purposes. In view of the fact that Divi-divi grows wild in inexhaustible quantities in S. America no one need be encouraged to cultivate it in Ceylon.

GENERAL.

SOME ACCESSORY FACTORS IN PLANT GROWTH.

W. B. BOTTOMLEY.

During the summer of 1913, a number of experiments were made at the Royal Gardens, Kew, on a series of plants to test the manurial value of Sphagnum peat which had been incubated with a mixed culture of aërobic soil organisms for a fortnight at a temperature of 26° C. It had been discovered that by this bacterial treatment the humic acid in the peat is converted into soluble humates, and this bacterised peat, after sterilisation, forms an excellent medium for the growth and distribution of nitrogen fixing organisms. As the experiments progressed it was evident that, in addition to the ordinary plant food constituents, there was present in the bacterised peat a substance which stimulated growth in a remarkable manner. Further experiments showed that this substance was soluble in water, and was effective in very small quantities. It was found that seedlings of *Primula malacoides* potted up in loam, leaf-mould and sand, and treated twice with a water extract of only 0·18 gm. of bacterised peat, were after six weeks' growth double the size of similar untreated plants, and it was noted that flower-production and root development were promoted equally with increase of foliage.

These results suggested that the growth stimulating action of the bacterised peat might be due to the presence of a substance or substances similar in nature to certain accessory food bodies known to play an important part in animal nutrition. The latter are also known to be soluble in water and alcohol, so the bacterised peat was extracted with absolute alcohol the extract was evaporated to dryness, and taken up with warm distilled water, portions of 100 cc., containing the extract from 1 gm. of peat, being placed in each of 12 flasks. Six of these were boiled for five minutes and all, including six other flasks, containing only distilled water, received 0·2 gm. of potassium phosphate ($K_2 H P O_4$), 0·02 gm. of magnesium sulphate and 0·2 gm. of calcium carbonate, and were inoculated with 1 cc. of a uniform suspension of *Azotobacter chroococcum*. The contents of two flasks from each of the three series of six were analysed at once to serve as controls while the remaining four of each series were incubated for eight days at 26° C., at the end of which period they were analysed by the Kjeldhal process for their nitrogen content. The results are given in Table I.

TABLE I.

Series.		Nitrogen content.		Nitrogen fixation.
			mgm.	mgm.
I. Complete food ...	1	Control ...	0·4	—
	2	,, ...	0·4	—
	3	Culture ...	4·6	4·2
	4	,, ...	4·4	4·0
	5	,, ...	3·6	3·2
	6	,, ...	4·4	4·0
II. Complete food + alcoholic extract of bacterised peat.	1	Control ...	2·6	—
	2	,, ...	2·3	—
	3	Culture ...	20·7	18·2
	4	,, ...	20·5	18·0
	5	,, ...	19·9	17·4
	6	,, ...	20·9	18·4
III. Complete food + boiled alcoholic extract of bacterised pest.	1	Control ...	2·3	—
	2	,, ...	2·5	—
	3	Culture ...	19·6	17·2
	4	,, ...	19·0	16·6
	5	,, ...	20·6	18·2
	6	,, ...	19·4	17·0

The results indicate clearly that there is present in the bacterised peat a substance which stimulates plant growth and which is of fairly stable nature, as almost equally good results were obtained with the boiled as with the unboiled extract.

In order to test whether the active substance is present as such in the original peat, or whether it is produced in the bacterised peat as a result of treatment, an extract of the raw peat was made in precisely the same manner as described for the bacterised peat and incubated as before. No increased growth was apparent in the cultures containing alcoholic extract of raw peat.

The active substance being evidently produced in the bacterised peat as a result of treatment, and since this treatment consists essentially in the production of soluble humates by bacterical action, a test was made to

ascertain whether the chemical production of soluble humates would be equally effective. Two equal portions of raw peat were saturated with solutions containing 1 per cent. of their weight of sodium carbonate, and were stirred at frequent intervals for several hours. One portion was allowed to dry slowly at room temperature and an alcoholic extract taken as before; the other portion was leached with water until the washings were colourless, the water extract was then evaporated to dryness and the residue thus obtained extracted with alcohol. The effect of both the alcohol extracts was tested with *Azotobacter* and again the cultures failed to reveal any stimulation of the organism.

The accessory bodies concerned in animal nutrition have been shown to be precipitated by phosphotungstic acid; the alcohol extract of the bacterised peat was therefore treated with phosphotungstic acid and a fraction separated which was used in solution in the proportion of 17 parts per million. This fraction was tested upon wheat seedlings : ten seeds were germinated in clean sand in each of nine pots which were arranged in three series of three pots each. Series I. was treated with a complete food solution (containing nitrogen, phosphorus and potash estimated as NH_3, P_2O_5, and K_2O, in the proportion of 400, 200 and 1,220 parts per million respectively). Series II was treated with complete food plus alcoholic extract from 10 gms. of peat per litre of solution, and Series III. with complete food plus phosphotungstic fraction from 10 gms. of peat per litre of solution. Each plot was treated with 100 cc. of its solution one week after sowing the seed and the treatment repeated once a week for five weeks at the end of which period the plants were uprooted, washed, dried, and weighed. The results are given in Table II.

TABLE II.

Series.	Weight of 30 plants. (green).	Increase over Series I.
	gms.	per cent.
I. Complete food ...	11·94	—
II. ,, ,, + alcoholic extract	14·46	21·1
III. ,, ,, + phosphotungstic fraction	15·45	29·4

The results indicate that the stimulative substance in bacterised peat is precipitated by phosphotungstic acid and that this phosphotungstic fraction is quite as effective as the original alcoholic extract.

Again, working by analogy with the accessory bodies concerned, in animal nutrition a further fractionation was carried out with silver nitrate. The final solution contained 0·35 part per million of the dry silver fraction and was also tested concurrently with the phosphotungstic fraction upon wheat seedlings as before. The results are given in Table III.

TABLE III.

Series.	Green weight 45 plants.	Increase over Series I.	Dry weight at 100° C.	Increase over Series I.
	gms.	per cent.	gms.	per cent.
I. Complete food	64·5	—	13·3	—
II. „ „ + phospho-tungstic fraction.	96·8	50·0	16·4	22·7
III. „ „ + silver ...	91·5	49·6	15·7	17·7

The silver fraction having thus given results approaching the phospho-tungstic fraction its effect was next tested on wheat seedlings in water culture. At first the growth of the test and control plants was approximately equal, but after the first fortnight the seedlings in the control set seemed unable to utilize the food elements supplied to them while those in the silver fraction series went on growing to the end of the experiment (50 days).

It has previously been shown that seeds of barley, oats, peas and flax fed to guinea pigs, contained no accessory bodies having a curative effect on scurvy, but that these were developed during germination. These facts indicating the possibility of the development during germination of special growth substances which enable the embryo to utilize the food material present in the seed, a further series of water cultures was carried out in which the wheat seedlings were carefully separated from their seeds as soon as possible after germination. The difference in growth between the control and silver fraction set was never increased more than 5 per cent. of its original weight, while at the end of the experiment the silver fraction set had increased 59 per cent. of its original weight.

It would, therefore, appear that during the germination of wheat seeds certain substances are formed which enable the young embryo to utilize the food materials present. The supply of these substances formed by the seed during germination is sufficient to establish the embryo as an independent seedling; then some other source is necessary. It has been shown that these accessory food substances are produced when peat (decayed vegetable matter) is acted upon by certain soil bacteria, and the natural inference is that during the bacterial decomposition of organic matter in the soil—that is during humus formation, these substances are formed, hence the beneficial effect of farmyard and other organic manures.—The specific action of these accessory substances is not known and experiments are in progress to test various hypotheses in this connection.—Monthly Bulletin.

BURNING OF CHARCOAL.

In consequence of the war the demand for charcoal both for heating purposes and for munitions of war has already greatly increased, and it is probable that this will be the case as long as hostilities continue. Owners of woodlands may find it advantageous to consider whether they could not profitably turn some of their less valuable material into charcoal. There is no great difficulty in manufacturing charcoal in kilns : the initial expenditure is small, and the amount of skilled labour required is not very great, while at

the same time wood which might not otherwise be utilised is turned to account. It would be unwise, however, to attempt to make charcoal without some skilled labour, and although it has been found possible in an emergency to employ 20 to 30 unskilled men under a skilled charcoal burner and a good foreman, there are some operations which only a skilled and experienced man can efficiently perform.

SELECTION AND PREPARATION OF WOOD.

Since it is important that carbonisation should proceed evenly, different woods varying much in density should not be burned in the same kiln. Thoroughly air-dried wood is most suitable, but green wood can be used if a small amount of dry wood is put in the centre of the kiln. Decayed wood should on no account be used. Large pieces of wood (i.e. of about 8 in. or more in diameter) should be split and trimmed straight. Crooked and bent branch-wood can be used only in short pieces. Usually cordwood in lengths of 2 to 3 feet is employed.

SITE FOR THE KILN.

Level, well-drained ground, sheltered from the wind* and in close proximity to the wood and to a water supply, represents the best site for a kiln. A sandy loam is the best soil upon which to make the hearth. The soil of the hearth should be of a uniform nature and for this reason the ground must be freed from vegetation, etc., and prepared as carefully as a garden bed. The centre of the hearth is raised 8 to 12 inches above the circumference, and slopes evenly down to it, in order that the liquids produced in the process may drain away and that the draught may be increased.

An old hearth is always preferable to a new one: In any case the admixture of charcoal dust from old kilns with the soil of the hearth produces conditions most favourable to efficient carbonisation.

Before the kiln is piled, a heap of brushwood or other easily combustible firewood should be burned upon the hearth in order to dry it.

The method of constructing and burning charcoal-kilns differs in detail from place to place. The method described below is the one followed in the Forest of Dean, but in general it may be taken as typical of the practice of English charcoal-burners. The illustrations† represent operations in the Sussex Weald, but they also are typical of the country.

CONSTRUCTION OF THE KILN.

It is found that convenient sizes for kilns are from 6 to 8 feet in height and 13 to 20 feet in diameter: a usual size is 7 feet high and 18 feet in diameter, giving a capacity of about $8\frac{1}{2}$ cords.‡

The first step in the construction is to build a central flue by laying two billets (about 1 ft. or 1 ft. 6 in. long) parallel on the hearth, and piling others across them, continuing in this fashion to a height of several feet: it is not necessary to build this flue to the total height of the kiln, the walls of the top part of the flue being formed in the process of packing the kiln. Around the flue other billets are closely stacked, leaning against it in a nearly vertical position, the thick ends being usually downwards. Dry, slender billets, are placed next to the flue, the thicker ones being placed about halfway between the centre and the circumference. When some progress has been made with the first tier of billets a second tier is commenced and later a third, and sometimes a fourth. Finally the kiln is made as symmetrical as possible by filling with thin sticks any spaces left by the packing: the top of the kiln is by this process made almost horizontal.

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* If the ground is not naturally sheltered wind-screens are used.

† Not reproduced.

‡ A cord = 128 (piled) c. ft. or about 64 c. ft. solid of cordwood.

COVERING THE KILN.

In order to exclude all air from the kiln other than that absolutely necessary to maintain carbonisation, it is covered with an inner and another covering. The inner covering consists of turf, the sods being placed grass downwards. This covering is built upwards from the ground, and varies from 2 inches to 6 inches in thickness. Where suitable turf is not available a covering of dead leaves or grass takes its place. An outer covering of damp earth or of a mixture of damp earth and charcoal dust, about 1 inch thick, is next put on commencing from the base and working upwards : this is lightly patted down with the back of a spade to keep it in place. The top of the flue is left open.

FIRING THE KILN.

Red-hot charcoal is thrown down the flue and the fire so made is kept well alight : when this is assured the flue is filled with small billets of wood. An iron plate is placed over the top of the flue and removed every few hours in order to admit more billets, which are rammed tight with a wooden pole. When the flue is filled with a mass of burning wood the plate is removed and the flue covered in with the same substances as the sides of the kiln.

The proper regulation of the burning is a very difficult operation, for which it is absolutely necessary to have the assistance of an expert charcoal burner. Constant attention is required day and night until carbonisation is complete : the process may continue from 4 to 6 days according to the size and quality of the wood. The burner is guided in his work by the colour and position of the smoke. When the kiln is first kindled steam is given off, which changes in time to a white, thick smoke and then to a clear, blue smoke. The method of regulation is to make vent holes to increase the draught and expedite burning, and to close vent holes and thicken or water the covering to retard burning. Vent holes are not made until the second day of burning : they are then made on the sheltered side of the kiln at about two-thirds its height. As the burning proceeds these holes are covered and others made lower down, each series of holes being covered in turn until the base is reached and carbonisation completed.

As the temperature rises and the moisture in the wood is converted into steam there is some danger of explosion. Great care is required to keep the cover in proper condition, so that it is sufficiently porous to let the steam out and not so porous as to let in too much air.

If through uneven packing or other causes hollows appear in the kiln, these must be filled : the cover is removed, the wood or charcoal inside pressed down and the hollow filled with half-charred wood or fresh wood and the covering replaced as speedily as possible.

OPENING THE KILN.

As soon as it is perceived that carbonisation is completed down to the base of the kiln, the covering is made air-tight. The kiln has now considerably shrunk and is only about 3 feet high. The outer covering is raked off with a long-pronged rake, leaving only the charred turf. The surface is smoothed down with a "rable" (a large wooden hoe) all loose dust being scraped off. Fresh damp earth is thrown on to form a layer of about half an inch thick, and finally the kiln is covered with a layer of fine dry dust to fill up all small holes and to make it air-tight. If large wood has been used the kiln is cooled down by sprinkling water on it after scraping off the first layer, but this is not necessary with coppice wood.

When the kiln is sufficiently cooled down the covering is raked off about one-sixth of the kiln on the sheltered side and the charcoal is drawn out with a long-pronged rake as rapidly as possible. The covering is next taken off the adjoining portions of the kiln and is thrown over the first opening to

prevent flaming and to reduce the amount opened at any one time. This process is continued round the kiln till all the charcoal is removed. A kiln is ready for opening on about the fourth day if small wood has been used and on the sixth day in the case of large wood.

As soon as the charcoal is removed from the kiln it is spread over the ground and sprinkled with water. All half-charred pieces are picked out by hand and reserved for filling the chimney of the next kiln. The rest is riddled through a wide-meshed screen and is packed into sacks according to size. The earth and charcoal dust remaining in the centre is riddled and is used for covering the next kiln burnt on the earth.

YIELD OF CHARCOAL.

The yield of charcoal depends upon many factors—the kind of wood used, the situation of the kiln, the state of the weather, the methods adopted by the charcoal burner and the degree of his expertness. In similar circumstances coniferous wood will yield more charcoal than wood from broad leaved species, and of the latter, soft-woods will yield more than hard-woods.

As a result of recent operations in the Forest of Dean it was found that $61\frac{3}{8}$ cords of cord-wood and $47\frac{3}{8}$ cords of pit-wood (all of oak) together yielded in 13 burnings 31 tons 19 cwt. of charcoal, i.e., a little under 6 cwt. to the cord.

Since a cord of oak cord-wood weighs roughly $1\frac{1}{4}$ tons and a cord of oak pit-wood a little more than this, the weight of charcoal produced was approximately 20 per cent. of the weight of wood used.

COST AND FINANCIAL RETURN.

In the Forest of Dean the burning is usually given on contract at from 18*s.* to 25*s.* per ton.* This sum does not include any payment for the cutting or preparation of the wood, which is provided ready cut. Such wood is sold at 5*s.* per cord, so that to the sum paid for labour about 15*s.* per ton of charcoal may be added for the value of the wood.

Besides labour and wood the only other considerable items of expense are sacks for packing and cartage. The sacks used in the Forest of Dean cost about $3\frac{3}{4}d.$ each and about 40 are required to pack a ton : they are returnable and can be used several times.

In normal circumstances charcoal in large consignments sells at from £2 to £2 10*s.* per ton on rail, while for small quantities (say two or three tons) such as are used for drying hops in the South of England, as much as £4 per ton may be obtained. At the present time, however, prices are higher, and large quantities are being sold at from £3 10*s.* to £4 per ton on rail.—Journal of the Board of Agriculture.

THE CULTIVATION OF POTATOES.

At the present time many householders will be especially anxious to curtail their domestic expenses by devoting increased attention to the cultivation of vegetables in their gardens and allotments, and all available land may in some cases be used for growing vegetables. In such circumstances few vegetables can be planted more profitably than the potato, and the following suggestions are offered for the benefit of those who cannot devote more than about an acre of land to this vegetable.

* When the burner is paid by the ton he may, if unscrupulous, water the charcoal to increase its weight, and it is, therefore, found convenient in some places to pay by the bushel.

THE SOIL.

Growers on a small scale can seldom choose the soil in which to plant, but they may do much to enable such soil as they have to produce a satisfactory crop. Potatoes do best in moderately light soil with good drainage. When heavy land must be used it should be thoroughly dug over during the autumn and winter, and should be prevented from becoming water-logged by being thrown up in ridges or narrow stetches if necessary. Twitch (couch grass), docks, nettles, or similar perennial weeds should be forked out, and if there is any reason to suspect that leather jackets (grubs of the daddy longlegs), wireworms (grubs of the click beetles), or millepedes (also known as false wireworms) are present in large numbers, the land should be repeatedly turned over as far as the weather permits. If the land is sandy or open in texture it may be improved by adding "humus;" that is, anything in the nature of dead leaves or decaying vegetable matter. Impoverished land should be enriched with stable or farmyard manure, which may be dug in during autumn or winter, or before planting in spring.

Lime should not be applied in large quantities to land on which potatoes are to be the next crop, as it may induce scab. Nevertheless, small quantities (say 7 lb. per rod) are beneficial in rich garden soils; and on heavy soils, or soils that have lain in grass for some years, 14 lb. of lime per rod may be applied. Lime corrects acidity and improves the texture of clay.

SELECTION AND PREPARATION OF "SEED."

Seed potatoes of a suitable size should be procured, or saved from the previous crop, provided it has been a satisfactory one. It is undesirable to plant the very small potatoes known as chats, or the largest tubers, except in the case of first early varieties. In the case of earlies, seed potatoes should not as a rule be cut. As potatoes lose their vitality if grown continuously in the same locality, frequent change of seed is recommended, and experience has shown that it is better to obtain seed tubers from a district farther north than that in which they are to be planted. It is customary with the best growers to procure new seed every alternate year from Scotland; in recent trials, however, Irish potatoes have sometimes given as good results as Scotch. In the warmest and driest districts a change is desirable every year.

All potatoes intended for seed should be carefully "boxed." Boxing is done by placing the seed potatoes in layers in shallow boxes, and keeping them in a dry shed or other place where they are exposed to light and air but not to frost. They then "green," and ultimately form two or three short strong shoots which produce more vigorous plants than potatoes which have been kept in the dark till they are planted. Large growers are often unable to box the later varieties owing to want of space, but small growers are advised to box the early than the late varieties.

Diseased potatoes should on no account be planted.

MANURING.

The potato is a gross feeder, and a liberal supply of soluble plant food is necessary for the production of a large crop. When it can be obtained, perhaps the best source of such food is farmyard manure, or, failing that, town stable manure. When such is available it should be used at the rate of 15 to 20 tons per acre—say 2 to 2½ cwt per rod. (A large wheelbarrow holds about 1 cwt.) On heavy land it may be useful to apply dung when digging the ground in autumn or winter, but on very light soils dung, moistened if necessary, may best be applied shortly before planting the tubers.

Alternatively, 1¼ cwt. of dung per rod may be applied, and at the time of planting ¾ lb. to 1 lb. of sulphate of ammonia. 2 lb. to 2¾ lb. of superphosphate and ½ lb. of sulphate of potash may be added; as the supply of the

ordinary potash manures will be very limited, ashes from wood or vegetable matter may be used instead, at the rate of 2 lb. per rod.

If no dung is available good results will usually be obtained by the application at planting time of 1½ lb. to 2 lb. of sulphate of ammonia, and 4 lb. of superphosphate per rod, in addition to twice the quantity of ashes already mentioned.

METHOD OF PLANTING.

The depth and distance apart at which potatoes should be planted vary according to the soil and the climate, but generally speaking potatoes should be planted fairly shallow. Where the soil is light and friable they may be put in at a depth of from 5 to 6 inches, and in heavy land about 4 inches. Early potatoes should be planted at the shallower depth in order that they may get the full benefit of the sun's warmth.

The standard distance at which early varieties should be planted from each other is 8 to 12 inches apart in the rows and 20 to 24 inches between the rows. Mid-season and late varieties may be given 12 to 18 inches between the sets, and 24 to 30 inches between the rows.

GENERAL CULTIVATION DURING GROWTH.

It should be the aim of all growers to keep the land in which potatoes are growing frequently stirred during the period of growth, and all weeds should be kept down. The plants should be earthed up the first time when they are about 6 in. high, and a second time about three weeks later.

This drawing up of the soil to the plants promotes the formation of tubers, prevents the soil from getting too wet, and supports the haulm. If the soil has a tendency to get wet the ridges should be made as steep as possible, but the covering of soil should only be sufficiently deep to prevent the potatoes as they form from being exposed to the air and light. Small growers when lifting a few potatoes at a time should lift alternate plants or pairs of plants, or alternate rows, as may be convenient, in preference to working straight through the plot. By doing so the ground is stirred and the plants that are left often bear a larger crop in consequence, while an additional advantage is that cauliflowers, cabbages, broccoli, Brussels sprouts, kale, etc., may at once be planted in the vacant spaces or opposite them in the furrows between the rows.

It is desirable to lift all potatoes as soon as ripe in order to avoid disease.—Board of Agriculture, Special Leaflet No. 18.

SWEET POTATO VINES AS FODDER.

Mr. Renner, Botanical Assistant, writing in the Journal of Agriculture, Victoria, draws attention to the value of the stem and leaves of the sweet potato as fodder quoting Mr. Katayama of Japan whose experiments and investigations therewith have led him to recommend this apparently worthless by-product as a valuable cattle food.

"Japan produces some 3 million tons of sweet potato per annum, representing the output of nearly 700,000 acres. Large areas which are unfit for rice cultivation owing to the steepness of the land are utilised for this purpose.

"According to Mr. Katayama the aggregate weight of stems and leaves per acre available for fodder purposes is about 5½ tons. The fresh material is said to resemble in composition the sugar beet, but with tannin in place of oxalic acid. This must be fed with caution and is best mixed with an equal bulk of dry hay or straw. The dry material is, however, the best and safest form.

"When the tubers are harvested the stems and leafage should be dried in the air and then stowed away for use. It is also possible to convert the stuff into a good silage in about 5 months, after cutting it up small."

The cultivation of sweet potatoes in the Island is spreading rapidly. In the Southern Province local varieties have for a long time been extensively grown, but of recent years the Cluster Sweet potato, introduced by the Society, has become very popular and its cultivation is being largely taken up through school gardens.

GOOD SEED.

The following facts may help to convince English farmers that it is worth their while to take the utmost pains to ensure that their seeds are good.

1. The amount spent on seeds in this country (cereals, pulse, roots, rape, vetches, lucerne, sainfoin, clovers, and grasses) amount to millions of pounds sterling annually, the value of the seeds named, sown in Great Britain in 1914, being estimated at nearly £7,000,000 (the average of four estimates).

2. Increased crops are proved to result from the use of seed of improved quality, having regard to purity, and power of germination.

3. The success of a given crop may depend entirely on the seed sown.

4. Seeds are perhaps more variable in quality than any other goods the farmer has to purchase. The *purity* of seed varies according to the manner of growth, method of harvesting, and clearing operations. The *germinating power* varies with the climate and exposure to weather during the period of growth—especially at the time of harvesting—as well as with the mode of harvesting and storing (either in the rick of after threshing). Old or dead seeds are sometimes mixed with fresh seed of the same species in order to increase profits.

5. Seed testing or seed analysis reveals the presence (or absence) of weed seeds, which have an enormous capacity for damage when sown broadcast over the farm in impure seeds. It has been estimated that about 16½ million pounds sterling per annum is lost by farmers in Great Britain in growing (and getting rid of) weeds, a large proportion of which are sown with agricultural seeds.

WHAT PURE, GOOD SEED MEANS.

A good sample of seed should fulfil several conditions, and farmers should be careful to purchase on this basis:—

1. It should be "true to name," or of the correct species.

2. It should be as "pure," or free from impurities, as modern knowledge and machinery can make it.

3. It should be "heavy," dry, fresh and vigorous, with a high power of germination or growth. In clovers the percentage of "hard seeds" should be low.

4. It should be of stated origin, i. e. British, or from a special country or locality.

5. It should be free from injurious insects and fungi.

PURCHASE OF GOOD SEED.

What steps can the farmer take to guard against sowing bad seed or seed of low quality?

1. The seed merchant should be asked for a guarantee (a) as to purity and germinating capacity, and (b) as to the weed seeds present, making the latter point an important part of the contract to purchase.

2. The farmer should purchase his seeds subject to the right of return if on analysis by a recognised agricultural botanist, the seeds do not come up to the guaranteed standard. Farmers should deal only with firms who are prepared to adopt this arrangement.

3. The farmer should be prepared to pay a fair price for the seed he requires: if he insists on a low price he is practically insisting on low quality. The examples given above show that the seed of highest cost is probably the best, considering the number of good seeds for 1*d.* only, quite apart from the introduction of weed seed.

Seed merchants should receive the hearty encouragement of farmers to supply only seeds of the very highest quality at a fair price. If they give proper support, farmers may expect good results. At the same time farmers need not pay an excessive price for their seeds.

4. Farmers should submit samples of the seeds they purchase, "under guarantee and subject to analysis," to a competent agricultural botanist at one of the Agricultural Colleges or to a County Agricultural Organiser and only accept the bulk on his recommendation to do so. Instructions as to sampling, labelling, etc., should first be asked for from the expert concerned.

5. In the case of seed mixtures for rotation grasses and permanent pasture, farmers should purchase the ingredients separately and mix them themselves, so more effectually ensuring that they get the species and quantities required.

EXPLANATION OF TERMS.

Dryness of Seed.—Seed which are well dried indicate that they have been well harvested and stored.

Germinating Capacity.—This means the number of seeds per hundred of the pure seeds true to name which will sprout under favourable conditions. *Energy or Speed of Germination* is the percentage of the pure seeds which will sprout in a given time.

Hard Seeds.—Clover and lucerne seeds may contain a proportion of seeds which do not germinate quickly because the seed-coat does not readily permit the entrance of water. These seeds are called "hard seeds." They may germinate after lying a considerable time in the soil.

Moisture Content.—The degree of dryness being important (see *Dryness of Seeds*), the amount of moisture present is often determined in seed control work.

Old Seed.—This is seed which is of such an age that it may be dead or will only show enfeebled germinating power. On occasion it is treated in various ways and used to be mixed with good seeds in order to reap an unjustified profit.

Origin of Seed.—This term means a statement as to the source of the seed—the district or country in which it was grown—e.g., *English* red clover, *French* lucerne, *Provence* lucerne, *Chilian* red clover, *Dutch* dogstail, *New Zealand* cocksfoot, *Danish* hard fescue, American timothy, *Canadian* aslike.

Purity.—This term indicates the amount or percentage of pure seed true to the species concerned, present in a sample after all other seeds (including weed seeds), chaff, dust, stones, etc., have been removed. All the latter are included in the *Impurity.*

Real Value.—Theoretically the real or true or cultural value of a sample of seeds is the percentage of the *pure* seeds present which will germinate; it is obtained by multiplying the purity by the germinating capacity and dividing by 100. Thus if the purity is 95 per cent., and the germinating capacity is 90 per cent., the true value is $\frac{95 \times 90}{100} = 85{\cdot}5$ per cent.

Practically, however, the cultural value must also depend on the seeds which are present other than those ordered.

Photo by C. Drieberg.

A SCHOOL GARDEN EXPERIMENT.

L. Sunn hemp grown for green manure. *R.* Paddy nursery-seedlings
——— to be transplanted on to land carrying sunn hemp.—

Species.—The seed should be of the kind or *species* ordered—"true to name." The species may in general be readily determined, but variety can usually only be determined by growing the crop from the seed.

Weight.—The weight of seeds is important, the heaviest samples of a species usually being the best: hence the weight per 1,000 seeds is often determined.—Journal of the Board of Agriculture.

WATER REQUIREMENTS OF PLANTS.

The Gardeners' Chronicle, assuming that water supply is the limiting factor in crop production, considers the results of investigations by Leather in India, and Briggs and Shantz in America, on the subject of the water requirements of plants. These results are expressed in terms of the amount of water required to produce one part by weight of dry matter.

Crop	Parts water by *weight.*
Grains	
Kursk Millet (Chaetochloa italica)	187
Proso or little Millet (Panicum miliaceum)	208
Sorghum varieties	223-273
Corn	300
Wheat	513
Barley	534
Buck Wheat	578
Oats	597
Spring Rye	685
Root Crops	
Sugar beet	397
Potatoes	636
Crucifers	
Cabbage, Turnip, Rape	640
Legumes	
Peas, Clovers, Alfalfas	788
Flax	905.

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PRICKLY PEAR AS CATTLE FOOD.

The Manager of the Government Civil Dairy, Bombay, says the Indian Agricultural World, has issued an official report on his feeding experiments with Prickly Pear. The results are shortly that if properly prepared (the spines being destroyed by singeing over a stove fire) and mixed with 6 per cent. of its weight of cotton seeds it is a cheap and wholesome diet for bullocks.

With one stove enough food could be prepared for a pair of bullocks weighing 1450 to 1500 lb. at a cost of 6 cents for oil and 20 cents for cotton seed, or a total of 26 cents.

When fodder is scarce prickly pear should prove a valuable stand-by No ill-effects were noticed during the feeding experiments, which occupied 6 months and are still going on.

AGRICULTURE IN JAPAN.*

Japan occupies an unique position for an island of its size, inasmuch as it traverses two zones, the temperate and the torrid, this being a result of its great length, which is no less than 3,000 miles.

In 1912 the percentage of farming householders was found to be 60. The tenant farmers amounted to 28 per cent., peasant farmers 32, while those who were both made up the balance.

The cultivated area occupies 15 per cent. of the total area, and half of this consists of paddy land, the value of which is two or three times as high as that of high land. Forty per cent. of this paddy land produces a double crop. After the rice is harvested and the water drained off various other crops such as wheat, barley, rape, green manure plants, etc., are raised according to the climate and other conditions.

On the high lands it is the rule to raise two crops, viz. a summer crop of soy beans, sweet potatoes, millet, hemp, tobacco, sugar cane, indigo or vegetables; and a winter crop of wheat, barley, rape or vegetables. In the neighbourhood of cities the cultivation of vegetables is extremely intensive with the production of three crops a year. In addition to the farm crops mentioned, the following are also grown on high lands, viz., tea, mulberry, paper-mulberry, fruits, etc. There are also large areas laid down in pasture or cultivated with fodder crops.

The industry of the people is such that they fill up the time available between the cultivation of land with subsidiary occupations, e.g. cattle and poultry breeding, sericulture, horticulture and handicrafts such as weaving, mat making, straw braiding, paper making, bamboowork, the preparation of starch, etc; while those who live near forests devote themselves to forestry, along rivers to fishing, and in the neighbourhood of large towns to job work. Of these sericulture has been found to be the most convenient and profitable and is undertaken by 30 per cent. of the farmers.

Agricultural administration is well organised in Japan, while ample provision is made for research and experimental work as well as for education. The co-operative movement is well established and is proving of great benefit to the farmers.

In Formosa, which is situated near the torrid zone, rice is the chief crop and next comes sugar-cane. Other crops grown are sweet potatoes, beans and peas, besides tea. Pig breeding is an important subsidiary industry.

The little work under review, though written in somewhat quaint English, is neatly got up and illustrated with a number of excellent photographs. Within a very small compass it gives the reader a clear idea of the progress made in agriculture and an insight into the life of that most indefatigable individual, the Japanese farmer.

* "Outlines of Agriculture in Japan"—published by the Bureau of Agriculture, Japan.

KILN-DRYING CORN AT ANTIGUA.

A. H. TEMPANY.

In accordance with instructions given by His Excellency the Governor, experiments have been carried out to test the effect of kiln-drying locally grown corn.

On October 23, 1914, the following samples of corn were used for the purpose :—

1. A 2-bushel bag of recently kiln-dried locally grown maize.

2. A 2-bushel bag of maize imported from New York.

3. A 2-bushel bag of locally grown maize, similar to I, but which had not been kiln-dried.

4. A bag of locally grown maize, similar to I, but on the cob.

The bags were put up in closed receptacles.

The conditions found, when the various experiments were opened (January 18), are summarised below.

No. 1. Locally grown kiln-dried maize. Quite cool and sweet; no signs of mould, no evidences of weevil attack, but a small amount of grain moth.

No. 2. Imported maize purchased from Benett Bryson. Badly sweated and hot; quite a considerable growth of moulds; very heavily infested with weevils; no grain moth.

No. 3. Locally grown maize which had not been kiln-dried. Somewhat sweated and hot; some growth of moulds; very heavily infested with weevil and grain moth.

No. 4. Corn on the cob. Cool and not moulded to any appreciable extent, but very heavily infested with grain moth and weevil.

The results of this experiment are interesting and instructive, the point being that any insect or fungoid trouble which arose must have been due to conditions in the corn at the inception of the experiment, and could not be due to infection from outside sources.

One may say that the results obtained can be regarded as definitely conclusive, and show quite clearly that if due regard is paid to conditions of storage, locally grown kiln-dried grain can be kept in good condition and moderately free from insect attacks for considerable periods.—Agricultural News.

EXPERIMENTAL DRYING OF BANANAS IN TRINIDAD.

L. A. BRUNTON.

The figs for this experiment were not all equally "full" or mature and in consequence ripened very irregularly, the most mature ripening in three to our days whilst the least mature took eleven days.

The first lot was put out to dry on September 13, drying being completed by the 21st, a period of nine days; there was, however, very little sun on the first day as it rained almost continuously, and only a half day's sun on the 17th.

The remainder were put out in two lots on September 18 and 19 respectively, and were ready for packing by the 25th. Two days during this period were rainy with very little sun. It is therefore evident that in favourable weather drying can be accomplished in from five to six days.

The procedure adopted was as follows : when the bunches were brought in from the field they were divided in hands, packed in a heap in the storeroom on a bedding of banana leaves and covered with dry grass.

When ripe the figs were separated from the hands and peeled, care being taken to remove the "strings" below the thick skin; they were then placed in rows on the drying floor of the cacao house, exposed to the sun and turned continually during the day, at night they were heaped up and covered with dry banana leaves, but this was only done to the last lot from the third to the sixth day: it appears to assist the drying.

If a sufficient quantity of bananas were treated the cost should not, I think, exceed two to three shillings a hundred.—Bulletin of Department of Agriculture, Trinidad.

SAFFLOWER IN THE DECCAN.

The following notes arranged after some experience in Western India should be of interest to readers.

BOTANY.

The cultivated safflower plant *(Carthamus tinctorius)* belongs to the Natural Order Compositæ. It is an annual, one to two feet high, with spinose leaves and yellow-coloured flower heads. In Northern India and Gujerat where the flowers are collected for extraction of a dye, these are reddish in colour and the leaves are nearly spineless. This is probably due to intensive cultivation, as the land is liberally manured and the crop often irrigated. The seeds have a hard, white and polished outer covering which is unmistakable in the undecorticated cake. It is worthy of note that the seeds are used as a poultry feed.

CLIMATIC REQUIREMENTS.

It is perhaps the most drought-resistant of all valuable oilseed annuals. It should thrive in any region of an annual rainfall of less than fifty inches. As a crop it is grown in the cold weather, where the minimum temperatures approach 55°F. the seeds yield the best quality of oil. Cloudy weather is unfavourable, as also is rain at the time of flowering.

It is the most valuable oilseed crop in the Bombay Presidency because it can grow all over the Bombay Deccan where the monsoon season is very short.

Linseed becomes of importance only in those districts which enjoy a longer monsoon season.

CULTIVATION.

It is only in Gujerat that it is grown sometimes as a pure crop. The land is fallowed during the monsoons, manured and well-prepared. With the approach of the cold weather in September-October the seed is broadcasted or it is sown with a drill 18 inches apart with a seed-rate of about 20 lb. to the acre. The top shoot, when the plant is nearing maturity, is nipped to encourage lateral branching. The flowers are picked in February for the dye they contain, the seeds when mature are also harvested.

In the Deccan which now retains the monopoly for the growth of the oilseed crop, this is always grown in rows alternating with the chief crop, which might be wheat, gram or the cold weather sorghums. The crop is never manured and is grown entirely as a dry crop. Very often, the safflower plants are sown as a hedge to protect the main crop from cattle, sheep and goats. The yield is in the proportion of about 1 : 100.

THE OIL.

The oil is used for culinary purposes and is very frequently an adulterant of ghee or gingelly oil. The "sweet oil" of Bombay is a mixture of safflower, groundnut and gingelly oil.

When extracted by the cold-dry method in a country *ghani* about 25 per cent. of the oil is yielded by seeds.

The oil enters largely into the composition of Indian hair oils, notably "Macassar oil."

It possesses good "drying" properties and as such should be considered one of the very best substitutes for linseed oil. When soaked into leather it renders the material waterproof and durable. This fact is taken advantage of by many cultivators who thus lengthen the period of service of their leather *mhots* and ropes used for irrigation purposes.

THE CAKE.

The oil-cake is valuable both as a cattle feed and as manure. When pressed in the country *ghani* the hard outer covering has to be removed. This makes the cake a valuable cattle food. The presence of husk is injurious to cattle at the same time lessening its value as a concentrated feeding stuff. It is important to note this, because the cake sold as a by-product of power mills in Bombay contain an undue percentage of husk which the manufacturers have not hitherto cared to separate (this husk forms nearly 50 per cent. of the seed).

Even as a manure, it is desirable to have the decorticated cake as this possesses nearly 7 per cent. nitrogen, while the undecorticated cake contains about 4 per cent. nitrogen. The beneficial effects of this cake as a top-dressing to sugar cane is not explainable from its nitrogen content. The experiments conducted at the Mangri Experimental Station (Bombay Presidency) conclusively demonstrate the superiority of safflower cake to all other oil-cake manures.

As a concentrated food for cattle its value in Western India, apart from its cheapness is, in its remarkable keeping qualities. Unlike other cakes, it never gets mouldy or rancid and may be kept for an indefinite length of time provided it is stored in a dry condition.

The future of this oilseed in the Bombay Deccan is assured. Its place in dry farming in arid regions is well worth further investigation.

H. L. VAN BUUREN (Jr.)

PROTECTION OF GRAIN FROM WEEVIL.

Fumigation with bisulphide of carbon is a satisfactory method of treating infested grain, though it is specially adapted to small quantities and is most successful when the temperature is not too low (50°F. and over). The grain should be put in a bin or air-tight receptacle, and the bisulphide poured into a shallow vessel or on to a folded cloth placed on the top of the grain. From 1 lb.—5 lb. of carbon bisulphide are recommended as the quantity necessary to treat 1,000 cubic feet of space, but it has been found in some cases that the smaller quantities have failed to kill all the beetles, and it is

therefore preferable to use the fumigant at the rate of 5 lb. per 1,000 cubic feet of space. The receptacle should be kept closed for 24—36 hours ; it should then be opened and the contents thoroughly aired. The grain will not retain either the poisonous qualities or the bad smell of the bisulphide, nor will its powers of germination be impaired. When fumigating the operator should avoid breathing the fumes, and on no account should a flame, a lighted pipe, cigarette, or even a live electric wire be brought near, since a violent explosion may be caused.

Carbon bisulphide has also been recommended for treating stores and mills. The amount originally suggested for this purpose was 1 lb. to every 1,000 cubic feet of space, but it is better to allow 5 lb, while it must also be noted that certain experiments in America have given rise to the statement that as much as 20 lb. per 1,000 cubic feet may be required. Fumigation at a low temperature is said to be unsatisfactory and this probably explains the wide variation in advice which has been given.

Fumigation is sometimes carried out with hydrocyanic acid gas instead of carbon bisulphide. In this case 1 oz. sodium cyanide (" 130 per cent."), 2 oz. sulphuric acid, specific gravity 1·83, and 4 oz. water should be allowed for each 100 cubic feet of space. The gas is excessively poisonous and must be used with the greatest caution. Further notes on the subject will be found in the leaflet No. 188, but fumigation at low temperatures should be avoided.

Owing to difficulties in using carbon bisulphide or hydrocyanic acid gas in mills and granaries, treatment by heat is often preferred in America. A temperature of 118°-120°F. is said to be sufficient to kill the weevils, and this temperature can often be obtained in summer by means of the heating apparatus already in the mill. It has been found that a moist atmosphere, caused by leaks in steam pipes, makes it more difficult to obtain the necessary temperature. The time required for the treatment naturally varies with the contents and nature of the building and the sources of heat available. Periods of 16-24 hours seem to be usual in America, though special radiators are sometimes installed for the purpose of obtaining great heat.

For cargoes in ships, thorough ventilation should be practised, this keeping down the temperature and ensuring dryness of the grain.—Journal of the Board of Agriculture.

RADIUM IN THE GARDEN.

In one of the many little garden laboratories that have sprung up experiments carried on for two years on radium and radium water as an alleged miracle worker in the garden and farm are reaching a triumphant conclusion this spring.

Seeing is believing. In a South of London suburb both in the house and in the garden are to be seen side by side groups of flower pots and pans sown with mustard seed. Some of these pots have been grown in a soil mixed with radium refuse, some have been watered with radium water, and some grown in ordinary soil. To the eye the results are quite conclusive.

In some of the radium pots every single seed has germinated and grown into a lusty sapling, and the older the plants the more remarkable is their superiority to those that have had no radium treatment. The superiority is in some cases—notably with such root plants as radishes—100 per cent.

Some of our biggest seedsmen are making similar experiments and find the results very striking.—Daily Mail.

STORING RICE.

To the Editor of the Tropical Agriculturist.

Dear Sir,

I should be very grateful if you or any readers of your magazine could kindly advise me on the subject of keeping rice.

We have to keep supplies in the jungle for our camps sufficient for several months, as during the rains it is impossible to get it transported by bullocks—the usual way. Paddy will keep quiet well, but the cost of transport is much greater and we are unable to get it pounded (husked) in the jungle.

We keep the rice in large receptacles made of bamboo, plastered round the inside with a mixture of clay and cow dung. After about two months it gets full of insects and goes musty. I have, on several occasions, had all the rice taken out and put in the sun for a few hours, but it does not seem to do it much good.

Any advice on the subject, as to proper receptacles, or treatment to keep away the insects and prevent the rice from going musty, will be most thankfully received.

Yours faithfully,

JAS. F. KEDDIE.

Siam, 31st March, 1915.

SUDAN DURA.

Again the unusually wet weather has interfered with the harvesting of this crop, and in consequence much of the grain of the white varieties is spotted with fungus. Neither does it thresh out as clean as it would if the weather had been dry.

But the red variety is not affected by the damp and has yielded well, 17 bushels (of 42 lb.) per acre, but with closer planting and better cultivation this would be greatly increased. The grain is large and sweet but will not give a white flour when ground. The birds do not seem to attack it in the same way as they do the white, probably on account of its colour. As it appears to be immune from wet weather, mould and smut, it should prove a valuable grain for the rainy districts. The seed is being carefully selected for re-sowing in order to obtain a quantity for distribution to cultivators next season.

Stem borer made its appearance but not in such numbers as to do much damage, but it is important that as soon as it makes its appearance (easily recognised by the grain-head wilting and the stalk breaking in half) all affected plants should be pulled up and burnt, and after harvesting all stalks should be burnt.

In the experiments for treating the grain against smut, which made its appearance in the September crop, the following is the result :—

1¼ acres were divided into ¼ acres and the seed from the same bulk sown broadcast ; some were treated with Bordeaux mixture, blue-stone alone, hot-water, Formalin, and some untreated. All plots germinated equally save the formalin, which completely failed. No smut appeared in any of the grain-heads, the untreated being also free. The experiment will be again repeated as it is a most important one.

In another experiment grain soaked for 24 hours and sown sprouting in rows 1 foot apart, gave a much better result than unsprouted grain sown broadcast. This experiment will also be repeated.—Progress Report, Peradeniya Experiment Station.

D. S. CORLETT.

THE TRADE IN PALM KERNELS.

The two chief products obtained from the West African oil palm are palm oil and palm kernels. The former is obtained from the pericarp of the fruit. The quantities and values of the exports of palm kernels in 1912 from each of the chief producing countries in West Africa are shown in the following table :—

	Quantities tons.	Values £.
Gambia ...	445 ...	6,518
Gold Coast ...	14,629 ...	205,365
Nigeria ...	184,624 ...	2,797,411
Sierra Leone ...	50,751 ...	793,178
Dahomey ...	36,708 ...	535,937
Gaboon ...	354 ...	4,671
French Guinea ...	5,054 ...	41,079
Ivory Coast ...	6,692 ...	70,710
Senegal ...	1,736 ...	28,221
Belgian Congo ...	— ...	110,835
Kamerum ...	15,742 ...	220,300
Togoland ...	11,456 ...	168,978

Almost all the palm kernels exported from the British possessions in West Africa are sent to Hamburg. In 1913, 241,961 tons of these kernels, worth £5,233,250, were landed at Hamburg. They are used as a source of oil ; their price during 1914 was about £18 per ton. The kernels yield from 46 to 53 per cent. of oil, which is extracted either by pressure or by solvents. It is used for the preparation of edible fats and in the industries : its price in the United Kingdom is from £36 5*s.* to £36 15*s.* per ton.

The cake seems to be very suitable for young pigs and for milch cows. For feeding purposes some prefer the cake obtained by pressure, as in that extracted by solvents all the oil is taken out. The following figures give the percentage composition of the cake according to the method of preparation :—

	Water.	Crude Protein.	Fat.	Carbo hydrates.	Crude Fibre.	Ash.	Value.
Expressed Cake	9·7	17·7	8·6	36·2	23·8	4·0	£6 8*s.* to £6 12*s.* per ton.
Extracted Cake	10·9	18·7	1·6	39·1	25·4	4·3	

In 1912, 133,816 metric tons of palm kernel meal or cake were made in Germany, of which 120,000 m. tons, were consumed in the country.—

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GOVERNMENT TOBACCO TRIAL GROUND, JAFFNA.

One of the variety plots.

Photos by H. F. Macmillan.

Native Tobacco under manurial experiments.